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S. HRG. 103–40

ENVIRONMENTAL TECHNOLOGY

Y 4. P 96/10: S. HRG. 103-40

Environmental Technology, S.Hrg. 10...

HEARING

BEFORE THE

COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

FEBRUARY 23, 1993

Printed for the use of the Committee on Environment and Public Works

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ENVIRONMENTAL TECHNOLOGY

TUESDAY, FEBRUARY 23, 1993

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

The committee met, pursuant to notice, at 10:03 a.m., in room 406, Dirksen Senate Office Building, Hon. Max Baucus (chairman of the committee) presiding.

Present: Senators Baucus, Kempthorne, Reid, Lieberman, Chafee, and Boxer.

OPENING STATEMENT OF HON. MAX BAUCUS, U.S. SENATOR FROM THE STATE OF MONTANA

Senator BAUCUS. The committee will come to order.

Today we open a series of hearings on the subject of environmental technology. It is a subject that is increasingly important to the future of our economy and it is increasingly vital to the future of our environment.

Last week, President Clinton, in his first State of the Union address, emphasized the importance of environmental technology to the stimulation of the national economy. Just yesterday, he and Vice President Gore reemphasized technology development, including environmental technology, as a major priority of this administration.

I welcome this long overdue attention. It is evidence that we are finally beginning to think and plan and act for the long term because nothing is more important for our country's long term success than a vibrant economy and a healthy environment.

I have initiated these hearings so that this committee can thoroughly explore this issue. What is the current state of development? What are the driving forces behind it? What are the problems to be encountered? It is my hope this hearing and others to follow, both in the full committee and subcommittees, will build a solid foundation for legislation to encourage advancements in environmental technology.

This is a broad topic. The most common type of environmental technology is so-called end-of-the-pipe control devices such as catalytic converters in cars or scrubbers on power plants. This technology is often the quickest solution to an environmental problem but it can also be the most expensive.

Another environmental technology involves changes in industrial processes to reduce emissions, materials or energy usage. This can include switching to recycled materials as a feedstock, or redesigning manufacturing processes to eliminate toxic wastes. In the process of making these changes, many companies have discovered greater efficiencies and reduced costs.

Environmental technology also encompasses changes to products themselves. In addition to consumer products, there are exciting new innovations in energy technology such as the development of fuel cells for automobiles and new ways of refrigeration that use less energy and generate less pollution.

The environmental laws this committee has helped to shape over the last two decades have been the driving force behind much of the development of environmental technology. Currently, there are approximately 750,000 people employed in pollution control and related jobs in the United States. These are good paying positions such as construction workers, engineers and manufacturing jobs.

In addition to creating jobs, developmental environmental technologies can save businesses money by reducing costs. That is critical if this country is to be competitive in the global market for environmental technology. If we don't become smarter and more efficient, someone else will. The competition for this new market is intense. The Council on Environmental Equality estimates that the global market for environmental technology to be about $300 billion and expanding at 5 to 10 percent per year.

Where is America in this competition? Sadly, we may be following some of our old patterns. Over the last two decades, we have seen numerous American inventions sold and successfully marketed by other countries.

When I attended the Earth Summit in Rio last summer with Senator Chafee, Senator Lieberman, and Vice President Gore, I was surprised to see that the vast majority of the pollution control technology is being marketed by Japanese and German firms.

American business has shown it can do the job. For instance, the electrostatic precipitator, an American invention to cope with particulates, is now marketed worldwide, but it is not enough to simply build these technologies and expect other nations to buy them.

Developing countries may not have the resources or expertise to implement these technologies. We must find ways to help these nations implement environmental technology for in doing so, we benefit our environment and American business.

Today, our witnesses will give their views on the driving forces behind the development and demand for environmental technology, its importance to our economy and how partnerships between government and industry can be used better to accelerate development.

In the coming months, there will be additional hearings on this topic before the full committee and the subcommittees. The development of environmental technology holds the key, I think, to protection of environment and development of our economy. As such, I believe it is appropriate for our first hearing of this Congress to be on this subject and I look forward to testimony from our distinguished witnesses.

I'll now turn to Senator Kempthorne. We have a rule in this committee that he who arrives first, speaks first, and Senator Kempthorne is the first to arrive. Senator Kempthorne.

OPENING STATEMENT OF HON. DIRK KEMPTHORNE, U.S. SENATOR FROM THE STATE OF IDAHO

Senator KEMPTHORNE. Thank you very much, Mr. Chairman.

I want to congratulate you, Mr. Chairman, for the forward thinking demonstrated in establishing this forum where we can examine the potential for a strong partnership between business, which is the engine for growth and prosperity of our economy, and the environment which is our life support system.

In addition, I think we should give greater attention to several other areas: One being that sound science and better risk analysis should be very important in setting our environmental priorities; a genuine reform of our regulatory regime and our environmental laws to remove existing disincentives for innovation; and careful selection of market incentives, including modification of the tax structure so as to harness market forces for environmental goals without being punitive and without losing sight of those goals in the push to raise Federal revenues to subsidize the congressional appetite for spending.

I appreciate the appearance of all the witnessess here today to give us the good benefit their expertise, and, Mr. Chairman, again, I congratulate you for what you are establishing here.

Senator BAUCUS. Thank you, Senator.

Senator Reid.

OPENING STATEMENT OF HON. HARRY REID, U.S. SENATOR FROM THE STATE OF NEVADA

Senator REID. Mr. Chairman, thank you very much.

I think the direction the committee is taking is excellent; the hearings that are planned for the future and the hearing today is what we need to do more of. It's important to note that the information that we gather here, by necessity, will flow into other areas of the Senate. For example, the Finance Committee on which a number of Senators from this Committee serve. We have to look, not only at what we do in this committee, but what the long term effect is, for example, in the taxing policy in this country. I think the work done in the Finance Committee can have an impact on what we do here. I also think that the list of witnesses that you've gathered here today is impressive.

I am scheduled to chair another hearing 10 minutes ago on the Legislative Branch Appropriations on which we've been given direction to make significant cuts in areas of that committee's jurisdiction which will affect the Legislative Branch operation. I'm going to have to excuse myself. I also have a hearing this afternoon with the Committee to Reorganize Congress, which I serve on. Hopefully, in the future, I won't have to miss important meetings like this.

One of the things we have to do here in the Legislative Branch is not only cut some of our spending but to cut some of our activities. We have far too much to do; it's impossible, literally impossible for one of us to meet all of our responsibilities. Therefore, we have to cut some of the responsibilities and we're going to do that. I think that will be what will come of the Committee to Reorganize Congress so that we have fewer subcommittees, fewer committees around here and that we can pay more attention to the work to which we are assigned.

I did, however, feel strongly about today's hearing and I wanted each of these witnesses to know that my staff will brief me on what transpired here. I will read every word of the testimony that has been submitted.

Again, Mr. Chairman, I congratulate and applaud the work that you have done thus far as Chairman, and certainly the work you will do as Chairman of this very important committee.

Senator BAUCUS. Thank you, Senator. I hope in your work in the Legislative Appropriations Subcommittee you look kindly upon this committee.

Senator REID. I'll be happy to trade you assignments. You can have that and I'll take this. [Laughter.]

Senator BAUCUS. Thank you, Senator.

Senator Lieberman.

OPENING STATEMENT OF HON. JOSEPH I. LIEBERMAN, U.S. SENATOR FROM THE STATE OF CONNECTICUT

Senator LIEBERMAN. Thank you, Mr. Chairman. Thank you for holding this hearing.

I have a prepared statement that I'd ask be included in the record.

I'll just say a few words of welcome to the witnesses and thanks to you for convening this hearing.

As has been intensely clear since the President's speech last week and the last couple of days, particularly yesterday out on the West Coast, this Administration is intent on creating a new relationship between government and business, between the public and private sectors aimed at how we can work together to create growth and particularly how we can work together to create new jobs.

We're focused here, under your leadership, Mr. Chairman, this morning on one of the areas of greatest potential for new economic growth and new job creation and that is environmental technologies, but it's not just going to happen with the marketplace working its will. It's going to need a little bit of assistance in the right direction from Government.

I can tell you from personal experience that I know I've shared with you before, Mr. Chairman, that we happen to have in Connecticut two companies that do a lot of pioneering work in the development of fuel cells, a clean energy source that many people think will be a major source of energy in the next century. We're not doing as well as we should in this area because the market can't quite sustain the work that these companies are doing because they haven't reached the level of development where their product is competitive with other energy sources.

One of the things that one of the companies in Connecticut has done to keep itself alive is to license its technology to Japanese companies which are being generously assisted by their government in the development of this technology because they see it as one of the major sources of energy in the next century. We can't let that continue to happen, either environmentally or economically and I think we're going to look, in this session of Congress, for ways to make sure that it doesn't happen.

I have cosponsored legislation with our colleague and fellow member of this committee, Senator Lautenberg, to promote environmental technology development and commercialization in a manner that's modeled after the very successful Small Business Innovation and Research Act. Basically, we would direct that a small percentage of the Federal Government's research and development and environmental cleanup funds be targeted toward development and commercialization of critical environmental technologies with a focus on pollution, prevention and clean-up technologies.

The GAO has found that the Small Business Innovation and Research Act has been extremely successful in moving new products from the laboratories out to the marketplace and we hope that the same strategy can work for environmental technologies.

Finally, Mr. Chairman, I want to say that I strongly agree with the statements made by Mr. Popoff in testimony that he'll offer today about the need to increase our technical assistance to small businesses, particularly in the areas of compliance assistance and pollution prevention. It strikes me that we have an interesting opportunity in the manufacturing technology centers, the so-called Hollings Centers that have been organized by the Commerce Department and that will be dramatically expanded in number under the Administration's proposal to ultimately 170 throughout the country.

These centers now offer assistance to manufacturers in manufacturing process innovations, but pollution prevention, environmental compliance and technology assistance have not been an explicit part of the package delivered by these centers.

I hope to work together with members of this committee and others to see if we can't broaden the charter of those centers so that they can serve to give small businesses exactly the kind of assistance that I think Mr. Popoff correctly says those smaller businesses deserve.

I look forward to the testimony and thank you very much.

[Senator Lieberman's prepared statement follows:]

STATEMENT OF HON. JOSEPH I. LIEBERMAN, U.S. SENATOR FROM THE STATE OF CONNECTICUT

Good morning. Thank you Mr. Chairman for holding this very important hearing and for your leadership role in this area.

The new Administration is committed to making the United States a leader not only in environmental protection, but also in the development and commercialization of clean technologies. I strongly share this goal, as I know you do Mr. Chairman. I also share the Administration's belief that there is no conflict between strong environmental protection and economic competitiveness. Indeed, developing clean technologies will play an important part in ensuring that we are economically competitive. If American companies are going to succeed in international competition, they are going to have to accelerate their productivity rate, and environmentally sound production is crucial to that process. As one computer industry executive explained to me, waste by-products are actually a cost in his highly competitive industry, a sign of inefficiency.

While our major competitors, Japan and Germany, have fostered the development of new environmental technologies through active involvement in all stages of research, development and commercialization, the United States does not have a coherent national policy to encourage the development of environmental technology.

I have seen directly what the lack of U.S. government commitment to clean environmental technologies can mean. As many of the members of this Committee know from prior hearings, Connecticut is home to two of the nation's fuel cell manufacturers. Fuel cells are essentially large scale batteries that use a range of fuels, hydrocarbon fuel, without combustion, to produce electricity. They are superlative energy producers, reaching efficiencies of over 80 percent if heat is recovered. They are virtually pollution-free and because of their great efficiency, emit far less carbon dioxide per unit of energy produced than traditional power-generating devices. All the lists of critical environmental technologies include fuel cells, including the work done by World Resources Institute as we will hear from Jonathan Lasch today.

But fuel cell manufacturers in this country are struggling because they lack the federal support that prudent energy and economic policy would dictate. Fuel cells are on the brink of commercialization, but our government is not acting to foster that commercialization here in cooperation with the private sector. Even as they struggle in this country, however, fuel cell and other alternative energy industries are forming the basis of an aggressive energy and economic policy in Japan --including support of the commercialization processs. That should come as no surprise to us, but it should serve as a warning.

I have introduced legislation, along with Senator Lautenberg, to promote environmental technology development and commercialization. The legislation is modeled after the Small Business Innovation and Research Act. It would direct a small percentage of the federal government's research and development and environmental cleanup funds toward development and commercialization of critical environmental technologies, with a focus on pollution prevention and cleanup technologies. The program has three very distinct phases with limitations on funding in each phase. The General Accounting Office has found that the SBIR is successful in moving products from the research and development stage into the marketplace: twenty seven percent of the projects reach commercialization within six years. As of July 1991, the program had generated approximately $1.1 billion in sales and additional funding for technical development--two key indicators of the program's commercial success, with an additional $3 billion expected by the end of 1993. The majority of this activity occurred in the private sector.

This legislation would help American industries to develop and market new products. New pollution prevention approaches will also increase the productivity of businesses. As we know from our work on the pollution prevention provisions of RCRA last Congress, the development of clean technologies can save businesses money by reducing costs associated with waste treatment and disposal, chemical accidents and other potential long-term liabilities. Pollution prevention approaches increase the average product yield, which translates into greater international competitiveness.

The development of new clean technologies also will directly benefit the federal government itself and the American taxpayers. Given the enormous magnitude of the cleanup obligations at federal sites, we are desperately in need of technologies that will address serious contamination problems in a more timely and cost-effective manner.

Finally, Mr. Chairman, I strongly agree with the statements in Mr. Popoff's written testimony about the need to increase our technical assistance to small businesses, particularly in the areas of compliance assistance and pollution prevention. NIST's manufacturing technology centers have done an outstanding job in helping to improve the quality of products manufactured by small and medium-sized businesses. But pollution prevention and environmental compliance and technology assistance have not been an explicit part of the packages of assistance delivered by these centers. My staff has been working with NIST and EPA on legislation to ensure as these centers grow in number, they include environmental assistance.

Senator BAUCUS. Thank you very much.
Senator Chafee.

OPENING STATEMENT OF HON. JOHN H. CHAFEE, U.S. SENATOR FROM THE STATE OF RHODE ISLAND

Senator CHAFEE. Mr. Chairman, I apologize for being late. I will just put my statement in the record and look forward to hearing the testimony.

[The prepared statement of Senator Chafee follows:]

STATEMENT OF HON. JOHN H. CHAFEE, U.S. SENATOR FROM THE STATE OF RHODE ISLAND

Good morning. Before welcoming our witnesses this morning, I would like to congratulate Senator Baucus for convening his first hearing as Committee Chairman on this very important and exciting topic -- environmental technology.

We are on the verge of undergoing some fundamental changes in this country. Over the next decade, we will begin to restructure our post-cold war economy and turn our attention to other pressing domestic matters such as restoring the environment and strengthening our economy.

The recent drive to develop, design, manufacture and apply environmental technologies is a promising sign of the times. These technologies can mean more jobs and a stronger economy today, and a cleaner more healthy environment tomorrow.

To ensure that the Federal government is investing its R&D funds in the most beneficial environmental technologies, we must first understand what makes a certain technology "green" and which "green" technologies offer the most promise for a better environment and more competitive economy in the future.

This morning's hearing is designed to provide some guidance on these questions.

As we will hear in a moment, the World Resources Institute has identified 12 areas of environmentally critical technology that they feel should receive Federal attention. The selected technological areas cover a wide range and include such areas as energy storage and application, biotechnology, and microelectronics.

Other witnesses will provide real world examples of the efforts they have undertaken to develop, implement or otherwise promote environmentally beneficial technologies. These witnesses are proof of the fact that many diverse activities and products can be considered under the rubric of environmental technology. Environmental technology can encompass everything from pollution prevention activities and product redesign to reduce pollution, to traditional end-of-pipe pollution controls such as catalytic converters and scrubbers, and even efforts to develop the so-called "high risk, high payback" non-polluting technologies of the future such as commercially available superconductor coils or photovoltaics.

Among the challenges facing us during this series of hearings are (1) to determine what policies might encourage or impede further development of environmental technologies; (2) how to establish priorities and select the most promising areas of environmental technology for further development; and finally (3) to determine what role the federal government should play in encouraging and developing these critical technologies of the future. I would like to welcome all of the witnesses before us this morning. I look forward to hearing from each of you.

Senator BAUCUS. Thank you very much.

Now let's turn to the witnesses. We intentionally have all six at the table at once so that we can get a dialogue going after giving your opening statements. So I encourage you to be thinking about this; also you might be thinking about the statements that the others make. You might want to supplement them, you might want to disagree, or whatever. In the John Lock marketplace of ideas, we're trying to seek the truth with a free interchange of ideas and discussion.

I'll also tell you that your full statements will be included in the record, so I encourage you to summarize. You each have 5 minutes, indicated by the red light. When it goes on, if you're not exactly at the end and you want to keep going just briefly, feel free to do so. I won't hold you rigorously to the 5 minutes but encourage you to respect the others.

First, I'll introduce the whole panel so we all know who is here. Jonathan Lash is President of the World Resources Institute. Dr. Frank Popoff is the Chairman and CEO of Dow Chemical. David Chittick is Vice President of the Environment and Safety Engineering Center of AT&T. Daniel Greenbaum is Commissioner, Department of Environmental Protection from the Commonwealth of Massachusetts. Dr. Donald Deieso is Executive Vice President of Air and Water Technology Corporation of New Jersey. Dr. Kay Adams is the Director of the Industrial Partnership Center, Los Alamos National Laboratory in New Mexico.

We'll begin with Mr. Lash.

STATEMENT OF JONATHAN LASH, PRESIDENT, WORLD RESOURCES INSTITUTE

Mr. LASH. Mr. Chairman, Senator Chafee, Senator Kempthorne, Senator Lieberman, it's a great honor to have this opportunity to address you today in hearing that I think is enormously important and shows that great foresight in beginning your work this year with this hearing.

It's a particular honor to appear on a panel with representatives of several companies who have been leaders in this field and have been innovators for a decade in the area of environmental technology.

I'd like to try to address four questions this morning. First, what is environmental technology; second, why is the development of environmental technology important; third, why should Government get involved in the field of development of environmental technology; and finally, I'll recommend a few steps that I think Government can take to foster the development of environmental technology.

I'd like to offer a fairly simple definition. Environmental technologies are those that reduce environmental risks through technical advances. There are two types: first, technologies whose primary purpose is to protect or enhance the environment and secondly, technologies that fulfill a function other than protection of the environment with less impact on the environment than otherwise possible. Let me give examples of both types.

The first is obvious. The electrostatic precipitator that the Chairman mentioned, scrubbers, groundwater remediation methodologies, are all of the first type of environmental technology. The second type is more interesting and involves more efficient use of raw materials or energy, changed manufacturing processes or changed products that cause less impact on the environment.

Some examples which I know other members of the panel will talk about are water-based solvents replacing toxic solvents and the cokeless steel mill that was recently developed in Germany that sharply reduces toxic air emissions in the manufacture of steel.

Secondly, I'd like to address the importance of these technologies. I think in order to realize their importance, one has to only think about what would happen if an American company perfected low-cost photovoltaics that were competitive with fossil fuel generation of power. They would immediately seize a huge market for power generation. Or, if as a result of the initiative announced yesterday by the President, we in fact are the first nation to develop an emission-free car, a hydrogen or electric car that is cost competitive and practical for normal consumer use, it would be a huge and stupendous market, and also, of course, have a profound effect on environmental quality, especially in urban areas where air quality still suffers as a result of automobile emissions.

The environmental benefits are obvious and necessary. In a world which will see almost inevitably a doubling of population in the next 50 years and which must not only achieve corresponding economic growth, but a faster rate of economic growth if the result of that doubling population is to be increased quality of life, not increased misery, we must find ways to produce that cause less impact on the environment. If we cannot find ways to be more efficient in our use of natural resources, it will be very difficult to achieve those twin goals of population growth and improved quality of life.

The result is that many more nations today, as was obvious at Rio, are demanding that their industries find ways to achieve economic growth and to reduce environmental risk.

The economic benefits of environmental technology are similarly compelling. There is a growing market for pollution control as the Chairman mentioned. The OECD figures suggest that the current market for pollution control equipment alone is over $200 billion a year and project that by the year 2000, it will be $300 billion a year, of which about one-third would be captured by U.S. manufacturers.

There is a growing market for green products across the world, but more importantly, pollution is simply another word for waste and waste is inefficient. Successful competition requires efficient manufacturing.

Finally, prevention is cheaper than remediation, as many firms have learned as a consequence of the Superfund legislation.

Why should Government act in this area? If there are so many economic benefits, why can't we leave it to the private sector who has already begun to innovate in this area to promote environmental technology? One answer was suggested by several members of the committee in your opening statements. The regulation, the regulatory process which has created demand for environmental technology has also created obstacles to the implementation of new environmental technology.

The purpose of the regulatory system is to decide how much pollution is acceptable and allow only that much and no more. The answer to that question has been so difficult for our regulatory agencies that we have tended to allow engineers to answer it by applying technology standards rather than performance-based standards. The technology standard is the most rigid restraint against technology innovation that you can imagine. If we're simply required to put a particular technology at the end of the pipe, it's very difficult to persuade a manufacturer instead to invest in the development of an innovative means of not producing the pollution that would be controlled at the end of the pipe.

Finally, there's the question of purpose. Where the protection of the environment is not the primary objective of a technology but rather manufacture of a product, there must be some other incentive for the developer of that technology to also seek to protect the environment. In the past that incentive has been largely regulation and public pressure. It would be useful if we can find ways to add to regulation and public pressure other rewards in terms of market incentives and public investments that will speed up the process of development.

One last example and then I will conclude, Mr. Chairman. One company in the United States has developed a highly efficient gas turbine that could be used for the generation of electricity using biomass fuels. The result would be that the generation of electricity would be neutral in terms of the carbon dioxide cycle. It would be a very important advance in terms of the world environment.

But if that company develops that technology, it will be competing with its own turbines and the benefits will flow largely worldwide and it will be difficult for that company to realize immediately so they have not pushed ahead with the commercialization of that technology and the only interest has been shown in several environment programs in the Environmental Protection Agency. An investment now in that kind of technology can pay off both environmentally and economically.

I have a few recommendations for Government action that could be undertaken to foster environmental technology. We need a national strategy on environmental technology. We need to coordinate. We need cooperation among Federal agencies and with the private sector. We need to identify critical environmental technology.

Our national strategy needs to identify ways to reduce regulatory impediments. It needs to provide assistance to States who may not have the technological ability to evaluate and permit innovations. We need to reorient our research priorities so that environmental technologies become one of the targets of the public research investment that is already made.

Mr. Chairman, thank you very much. I'd be happy to participate in the dialogue with the panel.

Senator BAUCUS. Thank you very much, Mr. Lash.

Next is Mr. Frank Popoff.

PART A

STATEMENT OF FRANK POPOFF, CHAIRMAN AND CEO, THE DOW CHEMICAL CO.

Mr. POPOFF. Thank you, Mr. Chairman, and thanks to the committee for the opportunity to share my views this morning.

In my written testimony, I hope to address the questions you've posed and to give some specific examples of what Dow is doing to promote technology development in the area of pollution prevention, waste management and minimization and energy conservation.

As background, I'd like to comment, if I may, on my industry, the chemical industry, and say it faces all of the competitiveness issues that are rampant in the economy today, issues of trade, competitiveness, of technology, of tax and regulatory reform, all the issues that face us, but we find, as the chemical industry, that we are on center stage, up front on one issue and one issue primarily. That is the issue of the environment, and rightfully so. I think we like that position. We see ourselves obviously as part of the solution more so than of the problem.

I think we have to understand that this industry, this chemical industry, is both the empowering capability that we have and a part of the traditional problem that we face. This industry is a high-tech, high-wage industry. It's a powerhouse in the economy. I think we know the statistics on trade. It's a huge generator of a $20 billion annual trade surplus with $45 billion of exports. It's a major player in investment spending. We spent last year $37 billion investing in our future. It's a research-intensive industry for both technologies to suppliers as well as customers. It's a supporter of education, not only at the university level, but more and more in math and science, grades K through 12. Certainly, I hope it continues to be a leader in environmental technology.

We've always believed in sustainable development. We've always believed that the environment and the economy are inexorably linked. Sustainable development says there can be no environmental reform without economic development and no economic development without environmental reform.

The theory of sustainable development is quite straightforward and relatively simple. The practice is much more complex, but I think we're finding in the evolution of things, some principles that are emerging, and I'd like to share three, if I may.

First, we must establish clear environmental priorities based on—thank you, Senator Kempthorne—sound science and good risk assessment. I think it's fundamental. Not all issues are created equal and we must address them logically and on a global basis. Mr. Chairman, on this point, you've been very, very clear. In your statement during the confirmation of the EPA Administrator, Carol Browner's address to her new responsibilities, you said we need to do a better job of setting priorities and focusing our efforts on our most urgent problems. I especially agree with you and the new Administrator that the EPA can and will substantially increase environmental protection while at the same time reducing the unnecessary administrative burden that goes with it.

My second principle is that we must make pollution prevention rather than end of pipe treatment our ultimate goal. New technologies can and will be a force in waste minimization in existing processes—existing processes are important; we have a huge investment in existing processes—but also in pollution prevention through new processes and new products.

At Dow, we've long recognized and understood the advantages of reducing waste at the source. In the mid–1980s, we launched a program—we formalized it, it had been ongoing—and we called it WRAP. We love acronyms—Waste Reduction Always Pays. Our goals were simple and straightforward, to reduce waste to the environment and to do so in the most cost effective and efficient manner possible. I think we've been successful on both fronts.

I should also point out, however, that of our environmental capital and operations budget of over $600 million per year, we spend most of our capital dollars, about 90 percent, on non-cost effective regulatory-driven projects.

My third, and perhaps most compelling, point is that we must employ market initiatives to bring efficient, lasting solutions to environmental problems. We must begin to develop and employ full cost accounting and full cost pricing of our products based on complete life cycle analysis, ensuring that the full cost, including environmental cost, is incorporated in our products.

Then, we must pass on that full cost to the ultimate consumer so that he or she can decide to consume or not consume based on full information free of hidden cost and subsidy. I'd rather get the bad news from the marketplace rather than any other audience.

In the aftermath of the Rio summit and in pursuit of the agenda that was put forth as Agenda 21, I think a very fundamental question arises. Will we deal with clean air, clean water, solid waste, energy, wetlands, forests, soil, global climate, biodiversity, population, all of the stated initiatives of Agenda 21 with more command and control, more legislation and regulation or will we utilize market solutions developed in concert between government, industry and the environmental community.

We're not saying we need no laws at all, far from it, but our challenge is to make those we already have on our books more efficient so that our laws and regulations can result in real reform and frankly, so that we can be proud of our legislation rather than apologize for its flaws.

The new Administration has said it will join industry and responsible environmental groups in endorsing an end to the adversarial relationship that has marked agendas for the past decades and replace them with the dialogue that we all seek. In this dialogue, it's my belief that industry's traditional call for incentives must be muted to some degree in an argument for less disincentives, less barriers, if you will. Disincentives must be countered through reform, regulatory, administrative reform you all address, not only to reduce bureaucracy and cost, but also to quickly get newer, safer, more efficient technology in agriculture and pharmaceuticals, in industrial applications, to the consumer as quickly and as efficiently as possible.

I won't elaborate on financial reform, but here again, significant disincentives exist in capital formation. The same is true in our addressed energy policy, yes, and in tax reform. Let's tax consumption to change habits rather than taxing production that destroys jobs.

Trade policy and practice, again devoid of disincentives, the U.S. need not fear global competition and, by all means, we need legal and tort reform. It is an impediment to U.S. producers who would endanger their long-term best interests in our litigious society by undertaking the risk that goes with new product development, even for environmental application.

In closing, I'd like to say that industry, I'm convinced, is prepared to come to the party and bring new technologies and new initiatives to the environmental scene around the world. With a solid set of priorities and with the kind of dialogue and cooperation that are, I think, seeing the U.S. assume environmental leadership around the world, we can be pleased with the portent of the decade ahead.

Mr. Chairman, Dow people, and I along with them, look forward to working with you in concert in your initiative. We hope that it is blessed with all the success it richly deserves. I look forward to your questions.

Senator BAUCUS. Thanks very much, Mr. Popoff. You've been a real leader in this area and it's been noted and appreciated by many. Thank you.

Next is Mr. Dave Chittick of AT&T.

Since everyone is taking a little more than 5 minutes, I'm going to turn the red light on at about 7 minutes.

Senator CHAFEE. Will that be it?

Senator BAUCUS. That will be it.

STATEMENT OF DAVID CHITTICK, VICE PRESIDENT, ENVIRONMENT AND SAFETY ENGINEERING CENTER, AT&T

Mr. CHITTICK. Thank you, Mr. Chairman.

First, let me join others in commending you for the foresight and vision you are demonstrating by holding this hearing. Integration of environmental considerations into the development of our technology and our economy will be a compelling challenge in the coming decades. If there is one objective I would like to see this hearing process achieve, it would be reaching a common understanding about the nature of technology and the environment.

I will concentrate on three points, Senator. First will be the difference between the general perception of environmental technology and what we call industrial ecology and design for environment. Second will be some examples of how AT&T and others are beginning to explore these broader concepts. Third will be some thoughts on how we might move forward in these areas.

Most people think of environmental technologies as the end of pipe control technologies. They may be quite advanced but they still deal with controlling the environmental impacts of materials that have no further economic use or, as Jonathan Lash said, wastes.

What we are talking about when we discuss industrial ecology and design for environment is very different. We are talking about restructuring the technological basis of industrial production to address sustainable development. We are not talking about devising better scrubbers; we are talking about recreating economic, legal and technical institutions, practices and systems.

My written testimony provides detailed descriptions of the concepts associated with industrial ecology and design for environment, but I want to spend a little time discussing design for environment here.

In general, it is a methodology by which environmental consideration and constraints can be driven into the product and process designed. Importantly, it looks across the entire life cycle of a product or process, not just the manufacturing stage.

Essentially, there are three stages to a design for environment analysis. First, the material, technology, process or product is evaluated. Second, the realistic option sets are defined and third, the environmental impacts for each option across its life cycle are evaluated. Within the constraints of the manufacturing, competitive, legal and economic systems put on those options, a rational choice can then be made.

Let me emphasize here that we in industry are not doing this yet. We don't know how. We don't have all the tools and we don't have enough data. We do have the vision and the drive and we are moving forward.

As an example of the design for environment effort, AT&T has initiated a pilot project, a product-specific study involving a small business telephone. The purpose of the project is not to design a telephone that we can unequivocally say is environmentally better than any other. In fact, we find we don't even have the data to know what that means at this point. Rather, we are looking at the product and trying to develop a scoring system which will tell us what is important and whether we're getting better or not at each life cycle design step.

Thus, for example, we're looking at how many plastic parts are used and are trying to make them from purer types of plastic. We're also trying to label them. Both these steps make the phone easier to disassemble,recycle or reuse components at the end of its useful life. What we are finding is that is a far more complicated task than we initially thought.

Take some of the things we've found when we looked at the manufacturing life cycle stage. For example, we find that we don't even have the data to understand the cumulative environmental impact of some of the materials we choose. Also, a telephone includes a number of different components, many of which we get from different companies and from different countries. In many cases, they regard the kind of information that we need as proprietary so they are not willing to give it to us. Complicating factors such as these make evaluating the environmental impact of the final product design quite difficult.

Perhaps the most ambitious effort to evaluate the environmental impacts of a complex product is that hosted by the Microelectronics and Computer Technology Corporation, MCC. Supported by a large technical workshop held last summer, a study of the life cycle environmental impacts of the computer workstation is scheduled to be released in March of this year. This undoubtedly is a path-breaking study, but even here the technical experts found significant, unresolved data and systems problems.

There are a number of other efforts going on but I think these give a flavor of where we are today. On the one hand, the technical and industrial communities are increasingly becoming engaged by this challenge. On the other hand, all these efforts are preliminary and tentative, more in the nature of experiments than anything else. Not only do we not have the answers, but in many ways, we are still groping for the right questions.

It is a time calling for innovation and flexibility. Progress could easily be stifled by inappropriate public policies and we all need to be flexible at this point. There will undoubtedly be many things this Government can and should do, perhaps some of them will be identified as we consider design for environment infrastructure issues more closely.

This raises the issue of the relationship between design for environment and other environmental laws, an issue I approach with a high degree of caution because I know my statements could so easily be misconstrued or misstated.

As Congress reviews environmental regulatory laws, I think it needs to assess the consequences of various provisions on the ability or incentives to integrate environmental considerations into private sector actions, something that Dr. Popoff discussed this morning. Environmental regulatory constraints are part of doing business, but we are becoming far smarter about the kinds of things we need to do to achieve real environmental progress. We need to be careful, it seems to me, that environmental regulation does not hinder our beginning efforts to evolve an environmentally sustainable economy, to maintain the competitiveness of private firms, and to support a healthy economy.

Our new understanding of the complex linkages between technology and environment involves all of us and cannot be resolved by government, industry or environmentalists acting alone.

Mr. Chairman, I believe this hearing is a significant and noteworthy step in the right direction.

I certainly thank you and the committee for the opportunity to express my views. Thank you.

Senator BAUCUS. Thank you very much, Mr. Chittick.

Next is Mr. Daniel Greenbaum.

STATEMENT OF DANIEL S. GREENBAUM, COMMISSIONER, DEPARTMENT OF ENVIRONMENTAL PROTECTION, STATE OF MASSACHUSETTS

Mr. GREENBAUM. Thank you.

Mr. Chairman, members of the committee, it's my honor to be here to testify before you today. I hope to share with you a few specific examples of how we, in Massachusetts, have tried both to work with companies pioneering innovative technologies in the State, but more importantly, to reform the way we do the environment protection business of the State so that we are actually encouraging rather than discouraging technological development.

I applaud the committee's interest and your interest, Mr. Chairman, in environmental technologies. It is only through innovation and creativity that we will solve our environmental problems and yet, it is in applying these new technologies that we can both build a vibrant new sector of our economy and improve the global competitiveness of American industry.

In Massachusetts alone, the environmental technology industry already comprises over 450 companies, employing 36,000 people with $5.2 billion a year of sales. Even in a slow economy, that industry has been growing about 5 percent per year and that growth is expected to accelerate.

Let me give you an example of a small company that is on the edge of that. There is a company called CERAMEM in Waltham, Massachusetts. They have developed a ceramic filter technology which was being used to cleanse air flows in a number of industrial processes. Now, in part as a result of the Clean Air Act and the increasing need for new, simpler and more durable technologies for air quality control, they are patenting and marketing that technology, that filter technology, in a series of applications for control of particulate and other emissions from everything ranging from factories to diesel locomotives. In part because of growing regulation and rules, they have already found a substantial national and international market.

There is much that we, as a Nation, can do and have done to encourage environmental technologies. We can provide technical assistance to companies, we can provide tax incentives, we can make envirotech a centerpiece of growth strategies for export markets, as we in Massachusetts are now doing.

There is probably no action we can take that will do more to promote environmental technology than to redesign the way we do environmental protection, first to provide strong, clear standards for reducing or eliminating pollution; second, to eliminate confusing, duplicative programs that freeze in place existing environmental technology at the expense of innovation; and third, to focus principally on pollution prevention which, in my view, can most effectively improve environmental performance as well as economic performance of American industry.

As the CERAMEM example showed, tough environmental rules can help create the marketplace. We have watched, as industries in Germany and Japan responding to tougher rules in those countries have started to actually take the edge from America in pollution control technology. We need to regain that edge.

Tough environmental standards will not alone encourage the development of environmental technology if they are to be implemented through the complex, fractured and confusing system by which we deliver environmental protection today. The confusion caused by duplicate environmental agencies and in some cases, by duplicate programs may have exactly the opposite effect.

Let me use, as an example, the way we in the States and at the Federal level do industrial inspections to assure environmental compliance. In nearly every State in the Nation, inspectors operate on three or four independent teams—one to look at air pollution, one to look at water pollution, one to look at hazardous waste. They may go into the same factory at different times during the same year looking for different environmental problems, giving different directions, and seeking solutions one pipe or one smokestack at a time. The result is confusion for the company, pollution being pushed around from the air to the water to the land, and no focus on developing the most cost effective technologies to reduce pollution at the source in the first place.

In 1990, Massachusetts initiated the Blackstone Project in which we retrained our inspectors who were visiting companies in the Blackstone River Valley near Worcester, Massachusetts. I should digress a moment and note that the Blackstone River Valley is of particular interest, I think, to Senator Chafee since in no small part the reason we chose the Blackstone River Valley was because the Blackstone River flows into Rhode Island and is the single largest source of toxic metals flowing into Narragansett Bay. It was words from citizens and leaders in Rhode Island that brought that to our attention and had us focus on that valley.

In this valley, our inspectors were, following training, no longer to look at individual pipes and stacks; they were to look at the whole factory, to send one clear and consistent environmental message, and to encourage companies to install technologies which reduced toxics at the source.

The results were impressive. The same number of staff could do 25 percent more inspections; the companies were pleased to have all of their questions answered at the same time, and nearly six out of seven companies inspected installed new pollution prevention techniques or technologies. Following that, with the help of our State Office of Technical Assistance, we have been able to foster the installation of a wide range of innovative environmental technologies and we are now expanding that program with the support of the United States EPA statewide.

We have, at the same time, included new incentives in our rules for companies to receive faster reviews or other benefits by taking the initiative to install prevention technologies. When the Polaroid Corporation sought to expand and renovate a film manufacturing facility in New Bedford, Massachusetts, they became the first company to benefit from the environmental waiver program enacted into law in the Massachusetts Toxic Use Reduction Act of 1989. They qualified for this waiver, which gave them a streamlined approval process cutting months off the time it took to get under construction, by redesigning their film-making processing to eliminate entirely the use of silver nitrate, sulfuric acid, methanol and other chemicals, and by installing technology to reduce the use of toxic solvents by between 90 and 100 percent.

In the long run, the most effective way to promote environmental technologies will be to redesign all pollution and protection programs to focus first on pollution prevention. The environmental rules we have developed have to be changed to accomplish this.

Last year, the United States Environmental Protection Agency launched the Source Reduction Review Project to scrutinize all of the rules which affect a particular toxic use industry, to simplify the rules to remove obstacles, and to build-in incentives for prevention. Similarly, EPA, last fall, issued guidance which actually encouraged States like Massachusetts to invest in initiatives like the Blackstone Project.

These efforts are heartening signs that we're beginning to see the change that's necessary to allow the States to innovate and new programs to come forward to encourage environmental technology. The challenge before us is enormous, but the rewards are equally great. With the right set of protection standards and incentives for prevention, we can inspire a vibrant new sector of the economy which adds jobs, reduces and eliminates pollution, improves American competitiveness, and regains leadership for the Nation in the international environmental marketplace.

Thank you for this opportunity.

Senator BAUCUS. Thank you very much, Mr. Greenbaum.

Next is Mr. Donald Deieso.

STATEMENT OF DONALD A. DEIESO, EXECUTIVE VICE PRESIDENT, AIR AND WATER TECHNOLOGIES CORP.

Mr. DEIESO. Mr. Chairman, good morning. Senators Chafee and Lieberman.

I greatly appreciate the opportunity to appear before this committee today.

Let me first describe quickly the vantage point from which I speak. Air and Water Technologies is the parent of the Research-Cottrell and Metcalf & Eddy Companies, respectively the oldest and largest air and water pollution control, equipment and engineering firms in the United States. We offer a full range of environmental technologies and services to these markets, including design, engineering, construction, service and maintenance and consulting services through 94 offices worldwide.

In proceeding, I'd like to share with you in capsule form, some observations about the state of the state, so to speak, of the U.S. environmental industry today, particularly concerning its financial health in our domestic economy, its competitive position overseas, and some measures the members of this committee may want to consider as you address the issues and bills that will come before you in the 103rd Congressional session.

For the record, I'm submitting a supplemental written statement that responds briefly to each of the seven questions you have posed for this hearing.

Let me start by describing the condition of the domestic environmental market and the pressures on those firms that provide environmental control, equipment and services. Contrary to previously held views, the environmental industry is not recession-proof or recession-resistant. The past two years have had as adverse an effect on this industry as it has had on other industries in this Nation. Employee layoffs, record losses, discontinuance of business lines and facilities have dotted the landscape of our financials as well.

As a specific example, during the hearings of 1988 and 1990, this committee heard months of testimony on the financial impacts on the regulated community of the proposed amendments to the Clean Air Act. Each of the affected industries provided to you estimates of the impact of the amendments on their operations and tallies of compliance costs. Amalgamated cost impacts of $10–$25 billion annually were generally accepted as true.

I'd like to report to you that 28 months after the passage of the amendments, the U.S. air pollution control market was smaller in 1992 than it had been in 1991, and that the 1991 level has remained essentially flat for the past 10 years at less than $1 billion per year. In short, there has been no real market impact from the amendments. I will leave to another time and a discussion the reasons for this and the serious implications of what this must mean to the goals of the Act. I will tell you, however, it has been a devastating blow to the air pollution control industry.

A similar picture can be drawn for the market impacts of Superfund, which as you well know, have been rich on legal expenditures and studies and lean on actual clean-up spending. Further, despite Commerce Department estimates and market studies which indicate national environmental expenditures of $80 billion per year today, the sum of the revenues from the major environmental firms reveal about one-tenth of that amount.

We are free to speculate on the reasons for the difference. An accurate, consistent basis for recording environmental expenditures is necessary. At this point, a toilet in a new office building is considered an environmental expenditure. Routine maintenance at an industrial facility is an environmental expenditure; rebuilding or building new manufacturing or process equipment in many instances is considered an environmental expenditure.

What all of this means to the environmental control industry is that the domestic market is filled with uncertainty and unpredictability, not a very conducive backdrop for decisions on R&D spending or new technology development.

Faced with the need to demonstrate earnings growth and recognizing the dwindling domestic environmental market in the 1980s, firms such as ours began pursuing offshore markets. As an example, today we have offices in Germany, Belgium, Italy, Denmark, Czechoslovakia, Japan, Taiwan, Australia, Saudi Arabia and Canada. In addition, we have projects underway in Indonesia, Singapore, Kuwait, Mexico and South and Central America. Nearly 30 percent of our revenues are based on offshore activity. You will find similar patterns of behavior among our competitors.

I offer you these facts to assure you that the U.S. environmental industry is technically quite competitive. There have been no shortage of good technical ideas and invention. In fact, U.S. engineers and scientists have led the environmental field. Our technology continues to be in great demand in the developing nations.

I must confess that our edge is slipping. During the past decade, environmental technology of Germany, Japan and France have taken their place next to ours. More disturbing is the fact that they are spending more today on developing and commercializing even better and newer ideas.

Also, when we face German and Japanese competitors on projects in developing countries, we lose many of these projects largely for one reason. We are unable to match the cost of capital brought by the German and Japanese firms. In many cases, our competitors have a government-sponsored source of capital. We have very little, if any.

In closing, let me offer several thoughts as you begin to shape your agenda for the 103rd Session. First, the environmental industry is technically competitive. Incentives to assist the next generation of technology will assure we will maintain our leadership position. EPA's outstanding programs of sponsored R&D, so powerful in the 1970s, are an outstanding method to seed innovation but has declined considerably during the past decade.

Third, with respect to capital formation, it is vital for our business to have access to cheap and easy capital if we are to be competitive in supplying environmental technology in developing nations. In the United States, sources are too diverse, they are in too many hands, and in many cases, nearly impossible for firms such as ours to negotiate.

Next, perhaps the greatest value to our industry is a strong, consistent and predictable regulatory agenda within our Nation. I served on the Clean Air Act Advisory Committee formed by EPA after the passage of the amendments. I must say to you that it was two years of the most frustrating time. A complete agenda of regulations were held up; both the regulated and the regulators on that committee were asking for action and asking for clarity and it was not for action of the EPA. In fact, in many instances, the staff appeared before the committee frustrated by an obstacle that rested in the Council of Competitiveness or OMB and asked the committee to exercise its oversight, as it has in the past in this matter, it would be of great help in moving many of these issues through.

In closing, our industry is a good employer. The notion that pollution costs and has a 2 to 3 percent negative effect on the GNP simply is untrue. We create jobs in construction and there are sales positions. We are an avenue for technical positions and engineers from the construction industries. We look forward to working with you over the next year.

Thank you.

Senator BAUCUS. Thank you very much, Mr. Deieso.

Our final witness is Ms. Kay Adams.

STATEMENT OF KAY V. ADAMS, DIRECTOR, INDUSTRIAL PARTNERSHIP CENTER, LOS ALAMOS NATIONAL LABORATORY, ACCOMPANIED BY JAMES P. SHIPLEY, PROGRAM DIRECTOR FOR APPLIED ENVIRONMENTAL TECHNOLOGIES, LOS ALAMOS NATIONAL LABORATORY

Ms. ADAMS. Mr. Chairman and members of the committee, it's my honor to be here today to mention some environmental activities ongoing at the DOE national security labs. I'd also like to mention that I have with me today, Dr. James P. Shipley, Program Director for Applied Environmental Technologies at Los Alamos.

We at Los Alamos who helped bring the Cold War to a successful conclusion believe the Nation's 50-year investment in multidisciplinary staff, diverse technology base and broad-based research and development facilities can be leveraged to solve our Nation's and the world's environmental problems. Ensuring that new designs and materials processes are developed and transferred to eliminate or minimize future environmental concerns is a goal to which we are in fact committed.

The taxpayers of this country are making an enormous investment in the environmental cleanup of the DOE complex. The current fiscal year 1993 DOE budget is over $5 billion and the current DOD budget is of a similar size which is around $4 billion. The lowest estimate is that the DOE alone will spend $100 billion over 30 years just to cleanup the complex. Even these numbers, as large as they are, pale in the face of some estimates of industry which is approximately $110 billion to comply with current regulations alone.

I might add in the work and money that we are spending in DOE, because it's compliance driven, we have very, very little money that's actually put into innovative research within the laboratories.

Since we are committed to cleaning up the complex, why not take advantage of the situation and spend our money wisely in the eye of a national return on investment. What I mean is, let's leverage the public investment and satisfy our ongoing environmental requirements of the national labs by partnering with American industry to accelerate the commercialization of innovative environmental technology. An investment in environmental innovation will, first, help our industries compete economically by complying with environmental regulations; second, make protection a valuable national resource more affordable; third, nurture a competitive high technology industry which is already facing tough competition from Japan and Germany; and fourth, help optimize the reduction of environmental risks per dollar spent. All these things have been mentioned previously.

The Los Alamos National Laboratory has a strategic goal to make strong, aggressive contributions to the economic competitiveness of the United States by leveraging the public investment of its laboratory, primarily personnel, infrastructure and technology expertise.

We specifically propose a three-pronged partnership approach which will systematically address the challenges facing this Nation. The first component is national challenges that are complex problems, the solution of which require the advent of new technologies and/or a massive integration of existing capabilities. Meeting this challenge should be in the public good. These challenges are broad and long-term collaborations with industry and government to accomplish high-risk, high-payoff ventures and should provide seed money for technology for future spinoff.

The second area is well-defined, near-term technology problems. These activities involve cost-shared partnerships with industry to codevelop technologies that are market-driven and may also directly benefit the U.S. national security. Most of our work is not off-the-shelf technology, but with very little investment we can make that so by working specifically with industries to do that.

The last component, which is very important, is to address the economic development of America through intensive collaborations with the laboratories and small businesses. In this way, we can concentrate on transferring our new and innovative technologies from the laboratories to U.S. enterprises.

In my written statement, I've mentioned many examples of exciting technologies Sandia and Los Alamos are developing with industry and a variety of different mechanisms by which we do that. However, I'd like to mention just a couple today.

The phasing out of chlorofluorocarbons is causing a crisis in the refrigeration and air conditioning industry which uses about 20 percent of the Nation's electricity. Los Alamos is contributing to extensive research activity in alternate cooling techniques like thermoacoustics.

With an industry partner and a cooperative research and development agreement, we are developing a thermoacoustically-driven orifice-pulse-tube refrigerator, a new invention that refrigerates with no moving parts, seals or low temperature orifices, only sound. It has no apparent lifetime-limiting features nor expensive components. It is exceedingly simple and consists only of assorted tubes and heat exchangers. No exotic materials are needed, only a brass, copper, stainless steel and helium gas required for our first model. This technology is so new that its ultimate limits will not have been probed for many years.

In the transportation area, we're developing the proton exchange membrane, PEM, fuel cell. This has important advantages—very low emissions, high energy efficiency, high power density, and the use of methanol as its fuel.

Since the early 1980s, Los Alamos has been engaged in research on the PEM fuel cell as an alternate power plant to the internal combustion engine. General Motors is now working with Los Alamos using both DOE and corporate funds to produce an electric vehicle powered by a 10 kilowatt PEM fuel cell. Besides being environmentally benign, this particular fuel cell-powered vehicle will have a range between refuelings comparable to that of present day passenger cars thanks to a much higher power density of the fuel cell.

For the Nation to thrive in an economic competitive sense, we must learn how to put good, new ideas into practical use and do it in a more cost effective way than our competitors are doing. So we recommend the following approaches. Let's leverage the Nation's 50-year investment in facilities, teamwork and capability at the national laboratories for our environment and industry environmental needs. We need to partner with environmental stakeholders and that includes industry, universities, regulators, and the public. We need to build an environmental infrastructure for the long term while cost effectively tackling immediate problems.

If all we do with the enormous resources that we spend on the DOE complex over the next 30 years is clean up that complex, we will have failed. We need to leverage and expand our R&D environmental technology that we can develop cost effective approaches by partnering with U.S. industry.

Thank you very much for this opportunity. I'll be more than happy to provide more details on specific initiatives that you might be interested in.

Senator BAUCUS. Thank you very much, Ms. Adams.

Let me ask a basic question of you, Mr. Chittick, and Mr. Popoff, and that is, why are your companies moving in this direction, why are you doing all this? To what degree is it because of your fear of upcoming environmental regulations; do you just want to get ahead of the curve and not put up with all the fuss? On the other hand, to what degree is it because you see new opportunities to improve your bottom line, whether market opportunities or efficiency opportunities? To what degree are you worried about the stick of additional regulatory control and to what degree are you taking advantage of the carrot of new opportunities?

Mr. CHITTICK. I think, Mr. Chairman, the answer lies in perhaps both what Dr. Popoff and I have said in various ways, dealing with pollution prevention, be it in control or substitution materials or where we hope to go in design and environment, has a market impact on where we are. What we are attempting to do, at least in our company, is to recognize that we must get ahead of the power curve; that to live with just say the technical limits of a water discharge permit is inviting disaster because statistically we're going to go out of control one of these days—by accident or by some problem.

What we are attempting to do, therefore, is to evaluate our processes and see how we might improve them. This might, by the way, have some impact on what has been stated as a kind of a lagging economy in the environmental pollution control equipment sales. May I make a suggestion just as an illustration of the point?

In Richmond, Virginia, we have one of the world's largest manufacturing facilities dedicated to the manufacture of printed circuit boards. To our great surprise, perhaps embarrassment, we found through the first SERA title III annual report that we were emitting tons—and I was trying to figure out what number that was but it was a very, very large number of tons—of methylene chloride, a commonly used material used in a stripping agent for photo resistors as we manufacture the wiring boards. Of itself, it is a very large emission that we had and could, if we went to the Clean Air Act provisions, probably we would have put enormous scrubbers on to control that emission.

Instead, however, we examined the process and with not a small or insignificant amount of capital and engineering research, have changed the process to one which is water-based and have almost completely eliminated—I look forward to this year, I think they will be under the trip values and will file no SERA title III report.

Senator BAUCUS. Dr. Popoff, why is Dow moving in this direction?

Mr. POPOFF. I must say it probably started with the stick but I think anyone who is objective today must understand the carrot is what drives this as far as new environmental technology. This is an ongoing process.

I think especially in the field of chemistry, we understand the potential to reform processes and products and to do so in a fashion that is economically viable. We also understand that the bill always comes due and I'll give you the example of Superfund. We carry $26 million on our balance sheet as potential liability for Superfund. That's a lot of money but it's really peanuts in the overall addressed Superfund. That decision was made by my predecessors to more or less not handle any waste outside our own premises, to do away with deep well disposal back in the 1960s and 1970s, to internally manage wastes and the dividends that has paid have been legion compared to the allocations of funds, reserves if you will, on other peoples' balance sheets.

I think the record is replete with the fact that pollution prevention does pay. Top that up with the fact that there are economic opportunities for new technologies and new products born to essentially ameliorate problems and prevent pollution. I think basically the carrot drives us today far more.

Senator BAUCUS. Basically, you're saying you can have both, you can have sustainable development by pursuing these initiatives whether they are remedial, prevention, or designed for environment or whatnot, you can improve the environment, but more important, you can improve your bottom line and it helps your business opportunities?

Mr. POPOFF. I'd be remiss if I didn't say that getting ahead of the curve, to use your phrase, is not only critical, it's something that has caught on in our industry. We recognize that if we voluntarily, proactively address some of the problems that are out there, that the solutions we reach with a common dialogue will be far better than the solutions that are achieved through mandates.

I think the Clean Air Act was a classic case in point. My industry was on point specific to air toxics. We sat down with the Environmental Protection Agency, put together stringent standards, left open the means of attainment, and then to top it all off, Bill Reilly addressed us on getting ahead of the 1995 date for compliance and he launched his 3350 initiative. We are well on our way before the law has come to be a reality.

Senator BAUCUS. Thank you very much.

Senator Lieberman.

Senator LIEBERMAN. Thank you, Mr. Chairman.

Mr. Deieso, I just want to come back to something you said in your statement to highlight it and make sure that I and everyone else understands it.

You talked about a dropoff in your industry, in the business you did in 1992, not only in spite of the Clean Air Act passing, which one would have thought would have been a boost to your business, but in some sense in light of the way it was administered. If I understand you correctly, I gather that your problem was the delay in the implementing regulations which created uncertainty among purchasers and therefore, they eased off on purchases. Am I understanding that correctly?

Mr. DEIESO. Senator, yes. I can elaborate further and say to you, probably in easiest fashion, I faced some very uncomfortable moments with the board of directors having to justify considerable business development and spending in anticipation of the work that would emerge as a result of the Clean Air Act.

I might add, incidentally, that many of the regulated community appeared before this committee and suggested there was a shortage of capacity in the air pollution control industry to support the measures of the Act. So a firm such as ours proceeded to build organizations, to develop, all in anticipation of billions of dollars of revenue that would flow.

Well, as I shared with you, in 1992, the market was actually smaller than in 1991. I happen to think there are several reasons that contributed to that. Very high on that list is that regulatory uncertainty. Regulation after regulation left EPA, in some form, some shape, only to find that as it moved to OMB or to the Council on Competitiveness, everything stopped, items were revisited and it's no doubt that our clients, the regulated community, simply took a position of let's wait and see what finally emerges.

Senator LIEBERMAN. Because they weren't sure what they'd ultimately need to buy?

Mr. DEIESO. Absolutely right. Senator, if I can add, even some would suggest today that they think many of the provisions of the Clean Air Act will be revisited by this Congress during the year in the hope of having some of those measures relaxed.

Senator LIEBERMAN. Your testimony and all of our interest in spurring the economy is another good reason not to revisit the Clean Air Act. Besides, the Chairman and others have spent multiple hours in room 224 of the Capitol and really do not look forward to revisiting that room.

Senator BAUCUS. It was around the clock for weeks.

Senator LIEBERMAN. Right, but I appreciate your pointing that out. It does show that again, in a very tangible way, the importance of predictability, governmental follow through and consistency here, so that the hesitation which presumably was a result of lobbying by other groups ultimately hurt you and hurt the economy, and that's an important lesson.

I gather from your written testimony that the fault here, as you see it, was not with EPA but with OMB and the Council on Competitiveness for delaying the regulations?

Mr. DEIESO. Senator, that's absolutely correct. Let me underscore the point.

In my position on the Clean Air Advisory Committee, we had opportunity to see countless regulations and those terrific staff at EPA who fulfilled all of the expectations you had of them. It was the logjam that then emerged after.

If I can underscore just one other point. The predictability that you mentioned, that the regulated community and industry such as ours demands, were also intended to create that level playing field in which the large firms such as Dow and AT&T who have moved way ahead, who have taken those measures, would have the comfort to know that mid-sized companies and small companies perhaps in competition with them, will also be similarly affected by those regulatory reforms.

Senator LIEBERMAN. Thank you.

As I mentioned earlier, this hearing could not be more timely in the sense that beginning with his address last night and in a little more detail yesterday, President Clinton began to detail a new affirmative relationship between the Government and the private sector to promote new high technology industries and jobs.

I'm curious if any of you on the panel feel that you understood enough of what's been said, from what you've read in the papers, to comment on whether you think the Administration is heading in the right direction in a way that will positively impact the development of environmental businesses and technology businesses in this country? Anybody want to courageously step forward? We can impose a draft if there are no volunteers for service.

Mr. GREENBAUM. I have a couple of comments on that. I think as I mentioned in my testimony, I think there are many incentives and Government funds that can be used to invest and make things move forward. The small company I mentioned in Waltham actually has benefitted over the last three years from small business innovative research grants which they only apply for in cases where they have products they think are commercially marketable.

The key to their success has not been, in their case, finding the dollars, although I'm sure that more of those dollars being available and done in more innovative ways will be helpful, but in fact goes back to the comments that Mr. Deieso made.

The key to their success is that the marketplace knows that we do in fact have to put on these controls or we do need to find a way to reduce. So along with the incentives programs, the joint research and development and technology programs, there has to be, it seems to me, a commitment to a thoughtful, well-put-together implementation of the rules in much the way many of us have commented on.

Another good example which we have seen in Massachusetts and throughout the northeast is the application of improved automobile emissions technology. In our view, the development of a financially and commercially capable electric car or an alternatively-fueled car, will only happen if there is a clear signal from Government and maybe the States—California has taken the lead but now the northeastern States are moving along with that—but if it is supported by the Federal Government, to say yes, in 1998 and 1999, you will have to have these vehicles in place, I would almost guarantee that we'll have them.

If we don't do that, if we delay, if we defer, if we ask questions about implementing those things, then a lot of the investment dollars are going to be delayed and deferred and the imperative to get them to happen will be delayed.

Senator LIEBERMAN. Thank you, Mr. Greenbaum. Let me just very briefly respond and say that I think you're right on target. All of us have talked about pollution prevention, both on this side of the desk and you there. I think it is our hope and the theme of the program for environmental protection in the 1990s, but it's not going to happen as we want it to unless the Government also sets some rules or creates some incentives. I think we all want to move away from command and control but I think the examples you cite of this as a carrot and stick probably simplifies it but there has to be a dynamic and more cordial tension here between Government and the private sector to really make this work.

Senator BAUCUS. Thank you very much.

Senator Chafee.

Senator CHAFEE. Thank you, Mr. Chairman.

First, Mr. Greenbaum, I want to thank you for what you have done in the Blackstone River Valley. That is very important to us, particularly the Narragansett Bay situation.

It seems to me, as I listened to the testimony, that we've been presented with one of the major problems we're going to be facing this year, particularly in light of what the President is saying. Namely, Mr. Lash and others seem to indicate that we ought to be able—and Dr. Adams likewise, I think—that the Government should be—if I'm misquoting you, you will get a chance to reply—that the Government should get in there and be helpful to these specific industries.

At the same time, we are confronted with that problem that always comes before us, who is Government to choose the winners and losers? The landscape is replete with examples where everybody thought such and such was the right route to go and it turned out it wasn't. Who would have said that mainframe computers have had their day and PCs and workstations are taking over, who would have said that 10 or 15 years ago? Indeed, anybody who invested in Apple computer stock about 10 years ago, would be very, very rich now because Mr. Scully was able to do something that nobody thought was going to happen.

What are we going to do? All of this to maintain Los Alamos, for example, costs us a lot of money. So one answer is, we'll increase the corporate tax rate. Well, Mr. Deieso has said that one of the handicaps that his business has is the cost of capital is too high and certainly he is not helped by the corporate tax rate going up.

Is everybody in agreement that our environmental regulations should be consistent, strong and predictable? That's the message I got from Mr. Popoff and it seems to me that is a consistent message. At least let us know what direction we're going and I take it Mr. Deieso was not enthusiastic about us revisiting the Clean Air Act?

Mr. DEIESO. I am not, sir.

Senator CHAFEE. Stay away from Room 224 is his message.

We're always confronted with the statement that the Japanese and the Germans are running away with an industry. They must have every industry in the world judging from what we hear in here and from the Finance Committee, but it doesn't quite work out that way. The United States, by the way, is the largest exporting Nation in the world. I congratulate you, Mr. Popoff and your industry for your surplus that you've generated in exports.

So what do you say to that, Mr. Lash? As I read your testimony; create a civilian technology agency to support critical R&D and direct the most important civilian R&D programs to allocate 10 percent to environmental technology. In other words, because all of these are Government employees, is somehow going to work on this successfully and we'll pay for it by increasing the corporate tax rate.

Is that your message, and explain who is going to choose what happens with this wonderful technology that's developed at Los Alamos, who gets it?

Mr. LASH. Let me answer your question but separate my answer from the corporate tax rate because we haven't taken a position on the corporate tax rate, but I think your question is right on point and let me address it.

First of all, the United States Government already has numerous technology support programs. We have the Advanced Technology Program, the National Manufacturing Centers, we have the National Science Foundation, Engineering Research Centers, we have the National Labs. We have a long history of identifying critical technologies, both in the defense area and in the overall Critical Technologies Program.

I would not suggest that the Government will have a uniformly successful record in identifying the most important technologies, always identifying the right winners, but that if we simply take the existing technology programs and reorient them so that instead of being overwhelmingly skewed toward defense from military threats, they are also oriented towards defense from environmental threats so that there is some effort of Government to direct technology support to technologies that will help the kinds of innovation that Mr. Popoff and Mr. Chittick have spoken of. That will be an enormous advantage because there is also a record of success from Government.

We should not do so until we have developed a coordinated policy for that. I would suggest that we could start with the existing Office of Science and Technology. You could ask Jack Gibbons to begin to lead an effort to identify critical technologies.

You'll find appended to my written testimony our own effort to begin to set some criteria for identifying critical technology. I think that's a doable task and essential.

Senator CHAFEE. My time is up but I'm extremely interested in your presentation, obviously. I must say there is a little bit of irony here in that we bitterly criticize other nations where the government helps out, and yet it seems to me that is what you're recommending here to a considerable degree.

I might say this isn't the last time we're going to discuss whether the government should this. In 1986, the whole purpose of the revisions in the tax code were to make the rates lower, do away with the credits and the deductions that were available and have individuals or business choose their own path, which way to go, instead of giving them all kinds of credits and deductions if they went the path that we thought they should go.

Thank you, Mr. Chairman.

Mr. POPOFF. May I take a try at that because I think we're not so far apart and it goes back to something Senator Lieberman said.

We all genuinely hope that a new industry, the environmental technology industry, springs full-grown onto our business scene, but we also recognize that the auto industry, the aerospace industry, the paper industry, the chemical industry, steel—you pick your favorite field—also have to prosper in this environment. I think bottom line, new incentives to new industries or existing industries really should be limited to research, development, application, initial commercialization but certainly not attendant to ongoing production. It's there and only there I think that the increased incentives are valid in a market-bases society and a market-based economy like ours. So I do think there is an important juncture as to where to draw the line.

The Airbus is an example of ongoing subsidization of production.

Senator BAUCUS. That's right.

Mr. POPOFF. We need no part of that, but I think using the best and the brightest to determine where our environmental technology should take us in new industries and existing industries is a very valid point. The standard-setting role of Government is one I think can leaven the addressed environmental reform that we all need across industries.

Senator BAUCUS. I think that's right. I think there is a line to be drawn between the R&D support on the one hand and the production and export subsidies on the other. The subsidies code addresses more the production subsidies than it does R&D. Airbus is a good example. They classify a lot as R&D but actually it's production subsidies and that's a bigger problem with Airbus.

Senator Kempthorne.

Senator KEMPTHORNE. Thank you, Mr. Chairman.

Mr. Chairman, I apologize for having to leave for just a few moments, so if I ask a question that has been asked, if you could just reference me to the record, I'll do my homework there.

Mr. Lash, in your opinion, how easy will it be to redirect not just Federal dollars but scientists and engineers away from the military R&D to environmental R&D technologies?

Mr. LASH. Well, you have an illustration in this panel. You have the National Labs here asking to be given that role. As we reduce investment in the defense establishment, I think it's inevitable that science establishment will seek that role and they have the skills to do it.

I would add just as a matter of interest, I was on a World Bank mission to Ukraine four months ago and even Ukraine is struggling to find out what to do with its defense physicists because if you think our defense budget has been reduced, you should see theirs. They have absolutely the best and the brightest in that industry and are redirecting them to the design of a pollution control industry for their industrial heartland.

Senator KEMPTHORNE. Ms. Adams, perhaps as a follow-up, if I may ask you, President Clinton has proposed a federally-financed worker retraining program. How important is that and is that necessary to bring about this very situation?

Ms. ADAMS. I think actually it is important for industries. I think within the National Laboratories, it's not quite as significant. I think a lot of the technologies we have built up over the last 20 to 50 years within the National Laboratories is of a sort that can be transferred fairly readily into the civilian sector for environmental needs and others as well.

Senator KEMPTHORNE. This I may direct to Mr. Lash, but anyone may respond if they would.

In the State of Idaho, for example, groundbreaking research is taking place in an area that I believe is consistent with your advocacy, Mr. Lash, of product design and process change. I'm referring to the integral fast reactor or the IFR research that's being conducted under DOE's Advanced Nuclear Reactor Program. The IFR offers an economically promising, inherently safe and environmentally sound solution to many, if not all of the concerns that have been raised about nuclear power.

We read in the book of Isaiah the concept of beating our swords into plowshares. The IFR has the great potential of taking nuclear warheads and converting them to civilian energy. Will the advocates for a Federal role in advancing environmental technologies recognize this kind of environmentally significant achievement and will they be supportive of this sort of project?

Mr. LASH. Senator, I don't know anything about the IFR technology, however, we have, in several of the studies we've published, advocated additional research in safe, standardized nuclear technology. We foresee that the demands of the Climate Change Program are such that the world's interest will continue in nuclear generation technologies.

Senator KEMPTHORNE. Does anyone else wish to comment on that?

[No response.]

Senator KEMPTHORNE. Mr. Popoff, the need to employ market incentives to achieve environmental aims has strong support with the concept among policymakers but I'm not always sure that everyone means the same thing when they talk about market incentives.

Would you please define for me, what do you, as an industry representative, mean by market incentives and how could policymakers go about making those available?

Mr. POPOFF. Clearly the issue of what is a market solution or a market incentive must be addressed because some of us that advocate market solutions may find the definition that ultimately is reached is not to our liking, so we've tried to articulate what our market solutions and indeed, we've come up with some do's and don'ts and some is and isn'ts specific to market solutions.

We've tried to say that they have to address sustainable development. There has to be a tradeoff between environmental reform and economic development. They have to have a quid pro quo that doesn't swing the pendulum in one direction only. They have to be basically adherent to standards but allow the market to find the methodology for achieving those standards. They must be driven by and addressed to choice, if you will, in terms of how we can get the desired end point. They must be fundamental to the fact that ultimately the polluter must pay. They have to internalize costs rather than dodge or defer, or pass them on in some fashion and see them ostensibly shifted to someone else or further into time. I think they have to be based on really sound science and sound assessment of risk and address the life cycle analysis.

We really don't know today in the debate for disposable versus nondisposable diapers, what is the true environmental impact? We sometimes take a single element of an issue and say that is the end point and we lose sight of the address to waste reduction that says reuse, reduce, recycle and recover and use that litany to get the full address to where should recycling stop and where might modern, safe, environmentally sound incineration take a position.

There is a great debate to be waged on this subject. I think a lot of work and thought has gone into it but unless we have soon common definition for market solutions, it's going to just become a buzz word and we will all suffer for it.

Senator BAUCUS. Thank you very much, Senator.

Senator KEMPTHORNE. Thank you.

Senator BAUCUS. Senator Boxer.

Senator BOXER. Thank you very much, Mr. Chairman. Forgive me for being late, I had a hearing at Banking at exactly the same time. I'm very pleased to be here.

To make a couple of points; first of all, to thank you for holding this hearing because it has always seemed to me that if business doesn't address this issue and if, we, the people, don't address the issue of pollution as it relates to growth in our economy, we're going to be stymied. We're certainly not anything like Eastern Europe, but when the walls came down, you couldn't see the cities and it's very hard to have economic growth when people can't breathe because if you can't breathe, you can't work. So it seems to me, we have to face this issue on both sides of the aisle and work together and make sure we build it into our policies.

I think the issues Senator Chafee raises of winners and losers is a very complicated one and I've tried to wrestle with it myself. You have to look back at this country and realize we always have picked winners and losers. If you were a defense contractor in the 1980s, you were a big winner. If you were in the civilian side, you were less of a winner. The question is, are we going to step back and not do anything because we're afraid to pick winners and losers. I think we have to step up to the plate with an economic strategy and see where we're going as a country because our competitors are doing this, and we have to do it.

I wanted to point out one interesting thing. When I was chair of a subcommittee on the House side, Mr. Chairman, we looked at NASA's research and development, and most of the impact of that research and development went to foreign countries because there was something in a regulation put in by President Reagan that said our private sector cannot share in this information. It seems to me that may have been fine in another time and another place but times have changed.

I want to ask a question about the defense military-industrial complex and how it could fit into this role. Ms. Adams, I read your testimony and you talk about how we can use the labs. I think that's very exciting. I'm assuming if you feel the labs can be utilized to come up with these new technologies, then you would believe that the workers of defense industries could be put to work in that fashion as well. Is that correct?

Ms. ADAMS. That's correct.

Senator BOXER. So it seems to me, this is an area, Mr. Chairman, where we could really look at conversion and have ways we can move these people into very important research.

I wanted to ask you, Ms. Adams, if you can see a situation that I can see where if we convert these labs in this direction and we do use, by the way, the $1.7 billion Congress appropriated last year—not a dime has been spent yet—to help our industries move forward, we do use some of that, we do have a proposal to reuse Fort Ord in Monterey by the University of California campus and the State campus become an environmental, high technology campus. And you match that with the R&D tax credits making them permanent, as the President has suggested, some targeted capital gains, we're coming up with some kind of interesting situation where we can put our people to work through the private sector, and some public sector, and develop technologies that could make us strong because are these not exportable technologies?

Ms. ADAMS. They certainly are. I think some of the biggest constraints in the past have been a lack of understanding of the commercial world because particularly in the security labs, they've operated largely in isolation. I think that's also been true of some of the defense contractors as well.

I think by working with industry and working particularly with civilian and commercial industries, they can learn how to do things differently so that the type of programs and the problems they are addressing are going to be driven more toward an economic impact rather than just a performance-driven type of impact that we had in the past.

Senator BOXER. I have one more question.

As I look at the situation, there are two issues. It's the clean-up of the mess we've all made because we didn't know what we were doing, and we're all forgiven, I know, and then there is the future so that we stop producing waste.

In terms of the past, my mother always said clean up your room before you leave the house. We haven't cleaned up our room yet and I'm very worried. You cite in your testimony extraordinary numbers—$100 billion to clean up—and it's affecting a lot of our communities across the country. We don't know how to clean up the mess.

I believe this is a Federal Government responsibility, because we made the mess, I'm wondering, if we use the labs for this purpose, in your view—and I would ask anyone to answer this—how close are we to coming up with some technological changes so that we can get into these military bases and start to clean them up because we're losing all these resources.

Mr. DEIESO. Senator, our firm has been the recipient of several hundred million dollars in Defense Department clean-up contracts. Those are part of the base closure program initiatives.

To the point of reprogramming Defense Department engineers and scientists from one mission to the next, let me say that the Defense Department engineers and scientists, on their environmental side, are among the finest anywhere. These are individuals who 4, 5 or even 8 years ago were supporting very different missions but with that dedication and commitment have formed one of the finest environmental groups certainly in the world.

To that point, these reprogrammings need not only be high tech applications. Quite a bit of the work we have at the military bases is simply moving contaminated soil from one point to another, incineration of materials that have been stored on-site, demolition of buildings with asbestos. It isn't much of a high-tech; it is the day-to-day matters in which the engineers and scientists are applying quite a bit of their background and skill.

I think it's perfectly possible; it's happening today. Much of it needs to be applauded and recognized.

Mr. GREENBAUM. If I might say, as the agency responsible for overseeing the cleanup of several major facilities just in Massachusetts this is only the tip of the iceberg if you look nationally.

Second, I would comment there is now increasing commitment and dollars obviously—these are monies that are going to be spent and should be spent to clean up these facilities—from the Department of Defense. I think the one challenge within that is to assure that as the Defense Department establishes its program to clean up sites and as the Department of Energy does the same, the emphasis is as much on the kinds of approaches being applied at Los Alamos as it is on very traditional techniques, looking at new techniques such as bioremediation.

Often these cases have large areas without an immediate, sensitive population, although there is no long-term risk, and you have the opportunity to try out techniques on patches of ground or patches of cleanup with bioremediation techniques that you wouldn't have as we wouldn't have if it was a neighborhood lot in the middle of an urban part of Boston or of Springfield, Massachusetts.

That mindset for innovation within the funding process is one that has to be carefully nurtured because you can get a mentality going—we've seen it even in the Superfund Program—where the job is to get the thing cleaned up, so we're going to take whatever is available and we're going to spend the money on that.

You don't want to hold up the cleanup but you also want to make sure there is a strong thread that says let's foster an explosion of new ideas and technologies.

Senator BOXER. If I could just make a 20 second comment. I would second that because when you start moving this waste from one place to another or burning it, you sometimes create other problems. So the point of the research and the development is to come up with new ways of handling it.

Thank you very much.

Senator BAUCUS. Thank you, Senator.

I'd like to address what I think is some confusion with the role of regulation in either fostering or hindering environmental technology. Some say that it's helped, it's driven environmental technology. Others say it hinders creativity and it's stifling.

Mr. Greenbaum, I would like you to address that. In what areas does it help, what areas does it hurt? I know you, in Massachusetts, have granted waivers in certain areas to help stimulate a solution to a problem in a cooperative approach. I'd like you to address a concern that some might have that that is just a loophole for lax environmental enforcement and that it's not protecting the environment.

Could you comment on where do regulations help, where do they hurt, and how do you deal with the question of the degree to which granting waivers is in fact a loophole?

Mr. GREENBAUM. I'm glad to do that.

First, I think the clearer the message is that we as regulators are delivering, the more they help. There are a variety of ways that can be clear. That can be clear when the standard of emissions is clearly set that you cannot be above a certain standard and you need to get to that by some date in the future. That certainly motivates the development of technologies. Often without that clear standard, you won't get there.

Secondly, I think we've seen substantial success in both Dow and AT&T, who have been leaders in this and have testified to this, in some of the less command and control and more public information aspects of government intervention through the Toxic Release Inventory, for example, have actually very strongly motivated action in many cases because they have brought to light in communities around plants, around facilities, things that were going on that were permitted and proper.

Senator BAUCUS. What regulations hinder the development of environmental technologies?

Mr. GREENBAUM. I was about to get to that. I think particularly when you look at the vast majority of American businesses that are dealing with environmental regulation—that is not, by and large the largest companies. We have about 13,000 entities, we regulate in one form or another in Massachusetts, of which perhaps 3,000 would be in the category of Dow or AT&T, Polaroid or a larger corporation. The remainder are small businesses. For those companies, two things occur.

First, the confusion of a vast number of programs coming at them from different directions actually often freezes action and stops them from doing things that they should be doing, feeling first, perhaps, that they are small enough, they can get away with it, they don't have to do it, feeling that they gee, I'm small enough, I don't want to try a new technology because it might not work. I'm going to take whatever is available off the shelf and it may not be either most effective but it at least gets me by the regulation.

That's where regulation, I think, harms this process. That's where many of the growth opportunities are.

Senator BAUCUS. Are you speaking particularly about small business or does that also apply to big business?

Mr. GREENBAUM. I think more than anything else, I'm talking about small business, the vast majority of businesses in the country.

Senator BAUCUS. The complexity hinders innovation from a small businessman's point of view?

Mr. GREENBAUM. It's the complexity, it's the lack of available technical assistance. You need to target the two together. It's the fact that they don't internally have the resources to have the expertise. The example I used of a waiver, and I will get to that point, was a waiver only granted after a demonstration made. The net result of this process that Polaroid was implementing was going to be a substantial reduction of the toxics used, not even toxics emitted, toxics used.

Senator BAUCUS. Before we get into waivers more, I'd like to ask the others if they have any views on where do present regulations, present law, State or Federal, hinder the development of environmental technology?

Mr. LASH. Three quick points. First, as I mentioned earlier, there is the problem of technology standards. Where we apply rigid technology standards, there simply is no incentive to develop process changes that eliminate pollution rather than capturing it at the end of the pipe.

Secondly, there is the problem of grandfathering provisions. Where older plants are grandfathered, where they don't have to meet the same requirements as newer ones, there may be good economic reasons but that eliminates all incentive to try to update those technologies.

Thirdly, there is the problem of the difficulty that many State permitting agencies have in evaluating proposals for innovation. Even where they are willing to be flexible, as Massachusetts is, they may face very complicated technical proposals which they feel uncomfortable evaluating and justifying to the public as meeting environmental standards, so they simply say, no, because it's safer to adhere to the strict technology standards.

As a former regulator, I know that I often faced the problem of having to say no because I had no way of knowing if the proposal was valid.

Senator BAUCUS. Let me ask the same question of the businessmen.

Mr. CHITTICK. Just one addition I would think to what has already been said, Mr. Chairman. I would add on to I think the excellent observation that Senator Chafee made that environmental regulations should be consistent and predictable, and I would add on to that, flexible and cost effective.

Back to the question, I think that Mr. Greenbaum accurately put the point to the problem, the large number of small industries, small companies who don't have the resources of AT&T or Dow Chemical. It would be probably of some interest to this committee if one piled in front of us the number of regulations, both State and

Federal, that a small businessman had to read through in order to understand how they might apply to that particular business.

Senator BAUCUS. I learned just yesterday, what 11,000 pages?

Mr. CHITTICK. We have estimated about 11,000 pages in the Federal Register and that's just new and proposed changes, not talking about 40 C.F.R. as it exists. Add on to that at least several hundred pages in the State Register, if the State does have a Register. In some States, we find it very difficult to get some method or system to keep up-to-date with the State changes in regulations.

Senator BAUCUS. Mr. Popoff?

Mr. POPOFF. I can only add one other thing. The most damaging regulation is that that preempts a more important one from being a reality and I go back to the issue of priorities. I really think that if we prioritize appropriately, we will regulate those things that require regulation hopefully using the techniques that we've talked about today. I think I'd go back to the issue of priority. We are cluttering our regulatory agenda to the point where we're not really doing what's in anybody's interest.

Senator BAUCUS. Thank you. My time is up. I'm going to come back later to waivers.

Senator Kempthorne.

Senator KEMPTHORNE. Thank you, Mr. Chairman.

To pick up on some of the comments Senator Boxer was addressing, with regard to cleanup of some of these defense sites, is it accurate to say that there are some very good companies that could be applying or submitting bids to do those cleanup jobs but that are leery of doing so because they are not indemnified against once they begin that process, they're going to be responsible for everything at that site? If that is the case, what should we do about it?

Ms. ADAMS. If I might refer to Jim here?

Senator BAUCUS. Would you state your full name, please, for the record?

Mr. SHIPLEY. My name is Jim Shipley. Thank you for the opportunity to answer the question. I'll do the best I can although we're a national laboratory and not directly in the DOD sphere of things. I think your question deals with that.

I believe that there have been hearings that addressed the question of indemnification in the DOD area and that's indeed a problem. There are companies out there that are leery of acquiring liability without fault, I think is the phrase. That is a very difficult problem to deal with.

We don't see that quite in such intensity in the DOE side of things, although it's going to be a problem for us, I think, in the coming years. It's proper for you to be worrying about that at this time.

Mr. DEIESO. Senator, if I can add, the large firms typically, while with expensive premium, do have the coverage necessary to proceed on the DOD projects. What has happened though is a bias to the large against the small and in a very subtle way, many of the smaller firms with very innovative approaches, bioremediation approaches, when asked to participate on the teams to address the DOD projects, find themselves incapable of producing the insurance coverage that's necessary.

EPA recognized this recently in their indemnification policy in work on Superfund sites and they too recognize the need to cover and to offer indemnification to the smaller firms if for no other reason than to have some of the clever ideas and approaches.

Senator KEMPTHORNE. So is it fair to say then that you would advocate that the same indemnification that is applied to DOE projects, EPA projects, should be extended to DOD?

Mr. DEIESO. Yes.

Senator KEMPTHORNE. Thank you.

Mr. Popoff, you had stated in your opening comments that disincentives must be reformed, minor crops. Do you deal with the minor crop pesticides?

Mr. POPOFF. Yes.

Senator KEMPTHORNE. How do we deal with that disincentive because we have so many crops that are considered minor crops and yet it is apparently not feasible currently for the chemical companies to reregister those pesticides?

Mr. POPOFF. I think you put your finger on the fact that not only is the minor crop issue one that does a disservice to our farmers, but the reality of how we put pesticides, animal health products, and a variety of agricultural products on the market is a source of concern to me.

The protocols are identical around the world. The two- year feeding studies, the tox work, the regimens and the disciplines are consistent from let's say the United Kingdom and the United States, and yet, in the final analysis, 2 to 3 to 5 years longer is required to get that product on the market. Hopefully, today it's a safer, more efficacious product, less persistent in the soil, grams per hectare instead of pounds per acre, and yet the address to petition and clearance in the United States is an adversarial one rather the collegial address that we're accustomed to in other parts of the world.

As a reviewer and a petitioner, we would, in the United Kingdom, seek to be on common ground as we seek a safer, more efficacious product. Here, as the reviewer, my principal job it seems is to prevent anything that might have any risk irrespectively of how that risk may be defined from getting to the market. That and the issue of the liability that goes with it and our need for legal reform, makes the cost not only of getting those minor crops addressed with new products to be registered, but the cost of defending anything that might transpire either real or imaginary on those crops, prohibitive. It's a real problem and it's fundamental to the system that we espouse.

Senator KEMPTHORNE. In Idaho, for example, although we're famous for potatoes, wheat is the only major crop we have. All others are minor.

I see that my time is about up.

Senator BAUCUS. Is the potato a major or minor crop?

Senator KEMPTHORNE. It's a major crop.

May I just ask one of my previous questions about extending that indemnification. Mr. Deieso answered in the affirmative. Ms. Adams also would you orally state that for me?

Ms. ADAMS. Yes. I think that would definitely be the case.

Senator KEMPTHORNE. Thank you very much.

Senator BAUCUS. Thank you.

Senator Boxer.

Senator BOXER. I had the privilege of being with President Clinton when he went to California and he and Vice President Gore talked about a national computer network, called it a computer super highway which could be accessed by business, by government, by schools.

I wonder whether from your perspective, because we are dealing with technologies of the future, if this is an investment you think it would be wise for us to make so that we would be able to have information that we don't have now at our disposal when we talk about these new technologies?

Ms. ADAMS. I think definitely that would be the case. That kind of capability would cut across a wide variety of industrial sectors. In fact, I can't think of one that wouldn't benefit from being able to have that capability.

Senator BOXER. We stopped at a place called Silicon Graphics, Mr. Chairman. It's amazing. I'm basically a low tech person and I now know that I can no longer continue in that mode as the Senator from California.

The bottom line is that they have capabilities now where you can look at a community, you can see it in 3–D, you can see from an overview, from an underview, from a side view, and it seems to me when we're talking about this environmental technology, the ability to see the world in a new way is going to make things a lot easier for us than the old-fashioned mapping and guesswork.

I just think if this investment is made and if it's made wisely, it could be tremendous in terms of the Government being able to be a part of this strategy.

Does anyone else care to comment on this?

Mr. CHITTICK. Senator, if I might. That technology or application of technology of that sort perhaps in my mind is best demonstrated by a project carried out by Dean George Pinder at the University of Vermont, former of Princeton University, using some very interesting computer graphics to predict the flow of underground pollutants and groundwater and thereby saving industry in where to put extraction wells and understanding the hydrodynamics of those problems.

These are projects which are in its infancy, although I think George has been working on this for about 3 years now or maybe more, and it's starting to pay off. There are those projects that are being carried forth.

I would just suggest that there is a role for Government and a role for industry and that as a member of the communications industry, I think that we have an important role to provide that communications link and the computing capability that is present.

What I'm saying I think is that how we take that intellectual property and put it in the hands of industry in the United States is a very valid question and what Mr. Deieso is questioning as well.

Senator BOXER. Thank you, Mr. Chairman.

Senator BAUCUS. Thank you, Ms. Boxer.

I'd like to follow up on waivers and how we foster this cooperative culture to help us move together to push environmental technologies.

What advice do you have Mr. Greenbaum? Where do you grant waivers, where not, and would your experience be applicable transferred to other arenas?

Mr. GREENBAUM. I definitely think it is. First, it may be useful to just understand where that waiver provision I described came from because I think it's part of that effort.

Senator BAUCUS. Mr. Lash said one problem is grandfathering. That's a form of a waiver.

Mr. GREENBAUM. That's true. The waiver I was referring to came, in fact, from a carefully crafted negotiation among all the parties interested in toxic use reduction in Massachusetts which was intended to both move the dialogue further along, put in place rules that got all businesses, small and large users of toxics, to move towards pollution prevention but at the same time provided incentives for industry.

So the first step there was to craft some consensus about this being available in the first place, that there should be a waiver and having everyone bought into that and not one group saying, the industry saying, I want a waiver.

Senator BAUCUS. The environmental community agreed, there should be a waiver?

Mr. GREENBAUM. It was part of an entire package and they agreed with that.

Secondly, I think you can't grant waivers cavalierly. There's got to be very clear standards for why you're doing it, and more importantly, a clear understanding of how you're going to measure that whatever is being proposed is in fact going to happen and have the environmental benefits claimed.

In the case I mentioned, the absolute elimination of chemicals altogether was quite easily trackable, it's clearly part of our ongoing compliance efforts with this company, so there wasn't really a question that we would get this waiver and then we would never know whether they actually did it. I think that's important. That verifiable, real benefit is very important, here as it is elsewhere.

Senator BAUCUS. Does that take significant additional resources?

Mr. GREENBAUM. I think it's a matter of building that into your normal compliance routine. It shouldn't add additional resources. In fact, this waiver saved us resources because there were certain up front reviews and processes that we didn't do. Process, we didn't change any standards, but processes that we didn't do that meant we didn't have to spend our time going over pieces of paper that were not going to affect one way or another the environmental outcome.

Senator BAUCUS. What dos and don'ts advice do you have for say EPA or other States.

Mr. GREENBAUM. I think first, see waivers as one part of an overall package of efforts to encourage pollution prevention, not as the be all and end all. Don't go for them in isolation. Secondly, however you want to cast it, a waiver or whatever, you have to have very clear standards to measure against both why you do grant it in the first place and then secondly, a clear way of measuring afterwards that in fact happened, some way of certifying that it occurred so that people can never say this is a loophole, this is just allowed somebody to blute because they got through this. Those are the two pieces I think are critical.

Senator BAUCUS. You also include technical, consultative expertise so that when you audit a company, you don't just issue violation notices, you work with them and say, here's a problem and here are some ideas about how you might solve them?

Mr. GREENBAUM. Absolutely true, particularly for the small businesses of the availability of that technical expertise and assistance is critical because often, as I commented, the way we would normally conduct enforcement or reviews of companies would tend to, if anything, freeze their actions and perhaps have them step back and not do anything or do the least possible when you really want to encourage them to rethink their process from the start. That separate agency could come in and help do that technical assistance. That is a key as well.

Senator BAUCUS. While we're on this subject of waivers, do any others have any ideas of how to encourage this because I think it's helpful? Mr. Lash?

Mr. LASH. I suggest a different terminology and not just as a euphemism. I'm uncomfortable with addressing what I think we're trying to address as a waiver. It's an innovative means of compliance. If you come into a setting in which you have standards and they are not being complied with, I don't think that you have the kind of setting in which you can encourage innovation.

If you're coming into an industry which saying we know what it costs to comply and we also know a better way to comply if you'll let us meet the standard without following each and every one of your rules. I don't see that as a waiver. I see that as building in flexibility.

I think the standards that Mr. Greenbaum offered are exactly the right standards to follow. If there is an atmosphere of trust, it will work.

Senator BAUCUS. I have a question about life cycle assessment. Mr. Popoff, you talked a bit about it and also Mr. Chittick. How do we do all of this? How do we begin to get a handle on assessing true costs? You both say it's difficult, I think we all know it's difficult but what initial steps do we take, either in the private sector or what advice do you have for this committee, or the Administration in how we can help encourage finding an answer to that problem?

Mr. POPOFF. There's an initiative that's begun in Europe that I think will be instructive. It presupposes obviously different values and valuation is the essence of life cycle analysis, so it brings together a rather disparate group of people to the debate to serve as something of a bureau of standards on what is life cycle analysis.

I think then it becomes testimony to engineering and assessment, each step of the assessment requiring some degree of consensus to really find out the total environmental cost of our actions.

It's not glamorous but it is necessary work that can be done. It's not going to be absolutely quantitative but it certainly can quantify to a degree that we don't have available to us today. I think the key is to get representation from Government, from industry and from the environmental community and begin to do the engineering job that's necessary to understand the environmental impact of our manufacturing processes and our overall address to producing our goods and services.

Senator BAUCUS. Mr. Chittick.

Mr. CHITTICK. I would agree with Mr. Popoff. It's what we typically call dog engineering. It is examination of infinite proportions perhaps but the key to it, I think, Mr. Popoff is correct in saying of the alternatives to a particular process or a particular material that goes into a product, what are the economic tradeoffs and the true economic costs of that material.

For example, if we change from lead to tin solder to bismuth tin solder, obviously bismuth is less toxic than lead, but where does bismuth come from? As I recall, it is a derivative of lead processing, from mining of lead. So we really haven't gained much. We've created perhaps the mining of more of the raw materials to extract one of the byproducts. it's in its infancy and we need a lot more data to wholly understand it.

I think the concept is clear that we ought to be careful when we change from one horse to another to make sure that we are really improving and not just changing processes for some surface kind of effect.

Mr. POPOFF. The hard questions are, how do we value energy, what is the beginning point for some of the natural resources that are ultimately employed, how do we value them? I think that's a debate that serves us well with or without the actual address to life cycle analysis. I know now we find that it's very much en vogue to assume that gas is a cleaner alternative to other fossil fuels. Yes, within reason, but again, some of those gas streams, some of those products are vital to other industries and other applications where there is no alternative at this time.

The complexity, I think, livens the debate but it causes us to focus on a broader arena. I think it's the single issue orientation that's gotten us into a lot of trouble where solving one problem has perhaps created a greater one in another area.

Senator BAUCUS. I'd like to turn a little bit to R&D now. It's my understanding that total R&D in this country is roughly $150 billion which is more than the total R&D of all the industrialized countries. It's split about 50–50, roughly $75 billion private, $75 billion public.

It's further my understanding that the private sector devotes a bit more to environmental R&D than does the public. The public I think is 8 percent of the budget, 92 percent goes to defense and agriculture and energy and so forth, and only 8 percent to environmental technologies, whereas the private sector devotes a greater proportion to environmental technologies. I don't have the figure. Should we in the public sector make a change here? Ms. Adams?

Ms. ADAMS. I certainly think so. Obviously we wouldn't be in the shape we are now if we had done that earlier.

Senator BAUCUS. Anyone else want to expand?

Mr. POPOFF. I think the bottom line on research and development is, does it manifest itself into investment? In other words, is it addressing successful projects that have ultimately been commercialized or put into the economy.

I think the statistic I saw recently said about 17 percent of industrial capital spending is going to environmental compliance and environmentally-related projects; 14 percent of industrial R&D is going to new products. That gives you some feel for how much R&D is being addressed to the reality of environmental reform.

I think it's fundamental to understand that industry sees environmental research and capital spending as critical to sustaining their existing business and we all crave new products obviously, but obviously we need to keep operational what we've already built. I think it's that piece of data that makes dramatic, in my mind, the address to industrial spending in research and development for environmental reform.

Senator BAUCUS. Is the Sematech example a good one here for environmental technologies? I know Sematech; it's roughly $100 million public, $100 million private. The consortium then decides among itself as to what makes most sense that has private application. I wonder if there is some kind of a partnership development that makes sense in environmental R&D.

Mr. POPOFF. I'll just quickly say that Sematech makes sense to do research, development, application, initial commercialization, but I think again, we really need to understand market forces as we address ultimate production. Otherwise, we'll turn an issue into a trade issue that will see countervailing duties, tariffs and all sorts of trade barriers enter the equation. I think the world would exonerate any nation for putting research money into environmental reform. I think the world would not exonerate the continued subsidization of enterprises that produce products and services ostensibly competitively.

Senator BAUCUS. A distinction between research and development on the one hand and production on the other?

Mr. POPOFF. Yes, Senator, I do.

Senator BAUCUS. Senator Boxer feel free to jump in here at any time.

Senator BOXER. I don't have any questions.

Mr. SHIPLEY. As sort of an analog to what Mr. Popoff was saying, at the national laboratories and in confirmation of your 8 percent number, this year, Los Alamos will spend a little over $200 million doing environmental restoration and waste management on our own facilities primarily. Of that $200 million, about $15 million will be spent on what one might call technology development, R&D, whatever you'd like, so that's in the ballpark of the 8 percent.

On top of that and kind of an analog to taking technology development and putting it into practice, we'll do about $25 million' worth of support for Westinghouse Hanford this year, to help them on their cleanup activities. That's not R&D. You can't really call it technology development; it's more like technology application, I suppose. It is the fruits of some of the technology development work we've done in the past.

So there is a kind of movement to try to put these things into place. I guess I would say it's an analog as I indicated to what Mr. Popoff said before in the private sector. You can't expect to be doing R&D unless you have some payoff and that's the way we're focused these days. We want to get the cost effective solutions to these things, but you have to make an investment to do that up front.

Senator BAUCUS. Do any of you have any strong feelings that the balance in this country is wrong? That is, we must move significantly more toward environmental technology R&D as opposed to other technology R&D?

Mr. DEIESO. Senator, if you study the R&D commitment made by the environmental protection industry, in that case by the affected industry, I think you'll find a few principles. First, it's that those budgets are completely a function of the financial performance.

Senator BAUCUS. I'm talking about public R&D though.

Mr. DEIESO. As we move to the public R&D, you in fact have a very effective program to some degree in the Department of Energy for clean coals technology. It's probably as close to the partnership idea in our end of the business as we'll find, and billions have been spent and supported with partnership arrangements.

In some instances, the companies that have been advanced and the ideas that have been advanced have actually been offshore companies and technologies from other countries. That brings another whole public policy issue to light. Our firm, among others, has lost bids to the Department of Energy for some of those projects and firms from Germany and Japan have won. That's another issue that we would put in the category of creating an incentive for U.S.-based companies to come forward with those ideas.

EPA always led certainly in the 1970s with those critical seeds of concept and idea. We're reaping many of the fruits of those concepts today.

Senator BAUCUS. Mr. Deieso, you said that America is doing pretty well, about a third of the international market but that we're losing our edge.

Mr. DEIESO. Yes.

Senator BAUCUS. What are other countries doing that you think we should look at that are applicable, practices that are applicable in this country?

Mr. DEIESO. Taking you through the sequence, in the case of Germany and Japan, the technologies they have developed that are now superior in some instances to ours, weren't generated in a laboratory because they are government-funded. Those ideas were spawned because there was a regulatory need in those countries for the technology.

Senator BAUCUS. So you like regulation?

Mr. DEIESO. Well, I find it an inescapable force for developing some of these ideas. In Germany and Japan, that's the case.

Senator BAUCUS. So you think that's the answer, tougher regulations?

Mr. DEIESO. I think it helps in the case of end of pipe; I think it certainly assists in setting the concept as to why industry will make this investment. Senator, it is, after all, nothing more than an investment and whether it's made by a venture capitalist, whether it's made by that industry, or government, there is a return that needs to be measured.

Senator BAUCUS. Do the rest of you agree that's where we should transfer from other countries to ours?

Mr. CHITTICK. I might take a slightly different approach to that, Mr. Chairman. First of all, I would like to think about this problem that you've posed about the role of government in R&D and would like to get back with some written material.

Senator BAUCUS. I'd appreciate that. (See p. 78.)

Mr. CHITTICK. Just off the top of my head, Senator, the reason I'm debating in the top of my head is that we have spend some considerable amount of research and development money to develop several alternatives to former polluting processors. The solid fluxor, for example, was a development of ours. We're now licensing and selling to even competitors of ours. It allowed AT&T to eliminate enormous amounts of CFCs used in our electronics processes. By the way, our first production facility, our first factor to go CFC as a result of that R&D work was Singapore

So if government is going to get into the R&D field for environmental reasons, is that going to stifle R&D in the private sector or why should private industry put investment into R&D and try to secure a return on that investment when the Government is going to do it.

Senator BAUCUS. In the Sematech example, it was the private sector that decided.

Mr. CHITTICK. That's a good example but I would also add the MCC example I had in my written testimony as another example. So there's a balance there that I was suggesting.

Senator BAUCUS. Mr. Popoff.

Mr. POPOFF. Let me say that I think regulation should be the last resort but the reality of regulation should always be with us. What I'm saying is that we ought to try to preempt the problems and anticipate the problems that ultimately we'll have to deal with through regulatory measures and find that there is good, common sense in achieving their resolution in advance of regulation.

I say this because, first of all, regulation, if it's to be successful, should be global in nature. Our products transcend our national borders; we all look at ourselves as exporters and importers; and we live often with regulations which are written in good faith but are contradictory in terms of means of attainment or in terms of scope.

So regulation is an element that does de-tune our economic ability to compete. I think what we've seen is some very viable addresses that are industry-driven. I know in my business, we've taken chlorofluorocarbons out of our foam products way in advance of the need to do so because we think that's a viable point to our customers.

Waiting for regulation to bite, sees people have taken on a compliance mentality rather than a preemptive mentality and they wait until the eleventh hour and then assume that basically there is no need to change a habit, there's just the need to comply with the new regulation, pay the bill. I'm afraid that's the flaw in a highly regulated society. I think basically it hasn't worked.

The problem is, do we trust the market sector to come to the party in advance of regulation? That's why I think the dialogue that's emerging between government, industry, and the environmental community can show the stick very clearly but keep the carrot fresh and attractive.

Senator BAUCUS. I'm surprised that no one yet has mentioned the role of energy in sustainable development. Why? Is there a role?

Mr. LASH. I think that many of the technologies that we've talked about are designed to more efficiently use raw materials and energy is one of the most important. There have been several mentioned, fuel cells, photovoltaics. Some of the biggest advances that have been made have been advances in energy efficiency and they will continue to be. It's enormously important that it fits within the field of technology

Senator BAUCUS. Anyone else on the role of energy?

[No response.]

Senator BAUCUS. I have another question, just a sort of basic one. What should this committee do, short term, long term? We have various environmental statutes that are coming up for reauthorization, the Clean Water Act, for example, RCRA, Superfund, the Endangered Species Act. What advice do you have as we reauthorize these statutes? That's sort of the short term. What about the longer term; what should this committee be doing to address and further the goal of greater emphasis on environmental technologies as a major role in sustainable economic development?

Mr. CHITTICK. I'd like to take a whack at that, Mr. Chairman.

If we look at the problem in three ways, one is the problems of the past; perhaps the second would be the problems of today; many of us have addressed the problems of the future, what we could do about those. I think that is perhaps a way to look at it.

We've been talking about technologies that are necessary to clean up Hanford and some other DOD sites. I think those are problems of the past and those need unique solutions.

The problems of today are being created by regulatory processes and industry trying to create new products within that regulatory frame. What I think Mr. Popoff and I both have stated in terms of pollution prevention and design for environment is talk to the world tomorow as to how we can create an industry and products that do not inherently pollute or at least pollute less than they are today.

The role of government, therefore—I would suggest you might be interested in examining the unnecessary barriers to innovation and flexibility. I keep adding the word flexibility because the Clean Air Act, as an example to our industry, and some of the draft regulations regarding permitting, had a process which one could extrapolate to be 18 to 24 months long. Mr. Chairman, we have products that are born mature and die in 18 months. So that we need the flexibility to create the regulatory climate to put these new innovations into our factories and still meet the constraints of the regulation.

Senator BAUCUS. Mr. Deieso said it is too flexible.

Mr. CHITTICK. I stand by my observation.

Second, I think, as a society, we need to perhaps prioritize the scientific-based environmental risks that we face and use our resources and financial resources to address those problems. Which problems are we going to face first?

Third, I think the country needs to figure out a better way to integrate our technology into our environmental structure. Many other countries have done so, as I think Mr. Lash pointed out, and perhaps we can find a way to do that as well.

Senator BAUCUS. Other advice for this committee?

Mr. GREENBAUM. Senator, I would suggest a couple of thoughts as you go about the very large agenda that's coming before the committee over the next several years. Some of them are themes that I think we've touched on here today.

First, it seems extremely important that as any piece of legislation is considered by this committee, that two things be very thoughtfully put into that. One is the philosophy and reality of prevention, all of the ways that program, that activity can encourage or discourage prevention and the development of prevention technologies.

Even today as we implement the Clean Air Act, for all of the good that it will do and is doing, and I would agree the regs have been slow but they're coming now, I have to wrestle at the State level with how to make sure that activity doesn't become an end in and of itself so that we are now telling all industries just to comply with the Clean Air Act and in the process creating a series of water pollution and other problems, but rather using the Clean Air Act as a way to get industries to look at the source again, not just at end of the pipe controls.

Thinking in each of these cases, whether it be the Clean Water Act, RCRA or others about prevention is very important particularly I would say in the Clean Water Act. I think the nature of the way that we have set toxic standards in that Act have been far less conducive to innovation and new technology. They've been much more technology-based. This is what we can do today, so that's what the standard is going to be and we need to move away from that. That doesn't mean we don't need to make progress, but in fact in air, we have a constantly improving standard that is applied.

The second thing in those Acts is I think it would be refreshing if we could design those Acts so that in fact the parts of EPA that implement each Act have to talk to one another. That's true in my agency as well. There are parts in my agency that implement each of those Acts that have to talk with one another, how to build those linkages to look at the whole facility they are regulating or the whole source of pollution, because we have very real work to do to clean up water or to clean up air but it is difficult if in fact everybody has their blinders on and is only looking at those pieces.

Third in this debate about flexibility versus standards, a common paradox is industry tells me just tell me what I have to do and I'll do it. So we tell them what they have to do and they say, wait, I want a little more flexibility. That's a constant back and forth.

I think there's a lot of room for flexibility on the process side of things, how long it takes, why do we go through certain reviews, how can you make things easier. That's what we waived in that one case that I talked about. I don't think there should be so much flexibility for what is the outcome we want here, what is the outcome whether it's zero discharge or a particular standard.

I think you could achieve both of those but certainly building that into the Acts and thinking about that is critical. Knowing the process you went through in lead and the Clean Air Act, it's an enormous process on any one of these Acts, but I would hope that as the process moves forward, those kinds of principles of prevention of interconnectedness, of flexibility in process but clarity and firmness on standards can find their way through to the end.

Senator BAUCUS. Thank you. I'm about ready to wrap it up here. Mr. Deieso?

Mr. DEIESO. Mr. Chairman, let me underscore the need for pollution prevention in your thinking going forward in each of those statutes as they are reauthorized. I would also say that end of pipe has a tremendous amount of application and that there is a fortune of installed base for which some pollution prevention measures are simply not on the menu.

I seem to be the one characterized as carrying the heaviest stick on the panel. Let me say that I understand the power of regulation as a driving force. Since environmental programs are rarely profit-making in the sense of manufacturing industry, it does require something of a force to make those commitments.

I applaud the market-based incentives, supported it during the debate of the Clean Air Act and certainly speak in favor of flexibility. The two industries represented on the panel today are truly exceptional in this country. Of the Fortune 10 or even the Fortune 50 that actually have R&D programs dedicated to the environment, we must understand those are exceptions. The majority of industry spends not a penny on environmental R&D and will take regulatory commitment only when they are forced.

As to the final point, the job versus environment is a cliche that seems to have developed once again. I thought we addressed that issue back in the 1970s when the environmental movement was spawned and started to develop. I'm afraid it's back again today. I think it was as wrong then as it is today. I think clearly any agenda we have must emphasize that pollution control is an integral part of this economy, it's an integral part of our society, and both government and industry share a common purpose in seeing that it is advanced.

Senator BAUCUS. Thank you all very much. Did anyone say anything whether a Senator or a panelist that deserves a response or needs a response? Here's your chance.

[No response.]

Senator BAUCUS. Anything so outrageous that it can't go unchecked?

[No response.]

Senator BAUCUS. Apparently not.

I thank all of you very, very much. You've been very productive, very informative and very helpful. You are all leaders and this is only the first step of many. I intend to follow upon this subject because it is so important.

Thank you very much. The hearing is adjourned.

[Whereupon, at 12:34 p.m., the committee was adjourned, to reconvene at the call of the Chair.]

[Statements submitted for the record follows:]

Statement of Jonathan Lash, President, World Resources Institute

Good morning Mr. Chairman and thank you for this opportunity to testify.

We are here this morning because of increasing concern over the connection between environmental technologies and American competitiveness. That concern is well placed. America's primary rivals, Japan and Germany, recognize that market demand for products and practices which are environmentally superior have already escalated throughout the world, and will continue to do so.

To remain abreast of Germany and Japan, the United States must change course, and develop a coherent environmental technology policy. This requires the accomplishment of three basic tasks. One is to move environmental factors from the periphery to the center of technology policy. The second is to reform environmental regulation to make it an engine of technological change instead of a deterrent. The third is to develop economic incentives to catalyze technology innovation. We have specific recommendations on how to achieve these three goals, and they are attached to this statement.

If the United States fails to adapt to the economic and environmental realities which have emerged in the last decade our share of a rapidly growing market will steadily diminish and our industries will pay a penalty for inefficiency and poor environmental performance.

An official of the Japanese government, speaking at a conference last October in Newport Beach, California described this market as follows, and I quote:

> *Japanese industry believes that there is an inescapable economic necessity to improve energy efficiency and environmental technologies, which also reduces costs and creates a likely world market. The potential profit in such a market is limitless.*

Indeed, Japan's Ministry of International Trade and Industry (MITI) will launch a new research program, called the "Leading Research Scheme" and among the research areas targeted is a program in Ecofactory Technology. This project is to focus on the design of factories to minimize pollution, reduce waste and reduce energy use rather than adding on costly pollution treatment devices.

The view that environmental technology will be a critical element in global competitiveness is shared by most of America's other competitors, especially Germany, where environmental and economic policy are viewed by the government as inseparable. Germany is, for example, now considered the world leader in the development of hydrogen technology, hydrogen has great potential as a non-polluting fuel of the future.

Furthurmore, as evidence of the potential market for environmental technologies, examples of the upward trend in sales of environmentally superior goods and services abound.

- Annual sales of high efficiency light bulbs increased two thousand percent in just six years.
- Sales of pollution control devices for both powerplants and cars are up, and so are non-polluting sources of energy like wind turbines and solar photovoltaic cells, which generate electricity from sunlight.
- So-called "environmental" gasolines--a term that didn't even exist five years ago--now are offered by virtually every major refiner and similar diesel products are now entering the market in California. Later this decade, electric cars that produce zero tailpipe

pollution will go on sale in that state in the tens of thousands. The list could go on and on.

The global trend toward environmentally superior products and services began to be noticeable in the mid-1980's. It was to be expected given the manifest global threats to the environment, ranging from pollution of the seas to global warming.

The World Resources Institute has undertaken a wide range of studies in an attempt to identify and evaluate technologies and practices which were environmentally superior. WRI was not alone. Many other institutions, including the National Academy of Sciences and the Congressional Office of Technology Assessment, undertook similar efforts. One question which has arisen consistently in each of these evaluations--indeed, it is the question which lies at the center of today's hearing--is whether the United States is trailing other nations in the development of the technologies and practices and, if so, why.

It is our judgment that, despite extraordinary achievements by individual companies, the United States has been, at the very least, slow to grasp the connection between environmental protection and global competitiveness. Whether or not we trail other nations -- and, if so, by how much -- is less important, however, than the realization that 15 years ago America was the world's leader in the development of an enormous array of environmental technologies, ranging from solar cells to fuel cells, and that the lead in many of these has slipped out of American hands and into those of Japan, Germany and other nations.

Environmental technologies are those that reduce environmental risks through technical advances. They are of two types. First, there are technologies the primary purpose of which is to protect or enhance the environment. Examples would include pollution control equipment, such as stack gas scrubbers, and remediation technology, such as biological agents used to clean up contaminated soil. The second type are technologies whose primary purpose is to fulfill a function other than protection of the environment with less impact on the environment than otherwise possible. Examples include the water based solvents developed by a number of U.S. companies to replace the toxic chemicals previously used, and the "cokeless" steel mill developed in Germany.

Both types of environmental technology are important, but it is the second that will have the greatest impact on the competitiveness of U.S. firms. In the past the market has been dominated by the first type, pollution control equipment because it can be added on to an existing technology, fitted to a smokestack, tailpipe or even a landfill. It is in the nature of our regulatory system to encourage such end-of-the-pipe technologies, but they have the disadvantage that they tend to move pollution around, not prevent it, nor do they encourage process or design changes that lead to energy efficiency and waste reduction.

These kinds of technologies will almost inevitably be with us into the next century simply because of the life times of the cars, powerplants, and factories to which they have been fitted. But they are already being replaced by newer and better ways of doing things. Some of these newer and better ways are process changes. Some are product changes. Whatever they may be, it is very clear that technologies are now emerging that are intrinsically less polluting, and these are likely to become the basis of the industrial infrastructure of the 21st Century.

Many of the technologies are better simply because they are more efficient. Fuel represents one-quarter to one-third of a powerplant's operating cost, and it make no sense to throw that money away in wasted heat. Pollution is merely a three syllable word for waste, and neither the world's economies nor environments can any longer tolerate the kind of waste that has characterized industrial activity in the past. For this reason the hall mark of many new technologies is efficiency.

Fuel cells, for example, are devices that produce electricity through a chemical reaction rather than combustion. They are not unlike batteries. The advantages of a fuel cell are numerous: they are small, compact, quiet, highly efficient and, if operated with hydrogen, zero-polluting. If these devices use some other fuels--natural gas or methanol, for example--fuel cells produce some pollution, but very little.

A conventional powerplant turns about one-third of its fuel into electricity. The very best of them reach 45 percent efficiency. Fuels cells, by contrast, range in efficiency from 45 percent to 75 percent, depending on the type of chemical used for the reactions.

Fuel cells are now in the pre-commercial stage. Many believe that they will be the powerplants of the future, providing heat, electricity and water in homes, hotels, and even as automobile engines.

Other technologies, however, are simply different than what we use today. Wind turbines extract the kinetic energy of winds to generate electricity. Today's versions can generate electricity for less money per kilowatt than a coal-fired powerplant.

Still other technologies facilitate efficiency. Genetic engineering, for example, may make it possible to produce food with less waste by developing plants which are resistant to pests and temperature extremes.

As the world learns more about the potential consequences of economic growth linked with rapidly increasing population there is increasing demand for technologies that use natural resources more efficiently and pollute less. With more people but the same amount of land, air and water, the world simply can no longer afford drive cars that waste four of every five gallons of gasoline and powerplants that throw away two of every three pounds of coal. Cleaner and more efficient ways of getting the job done are good policy, good business and, I believe, inevitable.

This trend is evident in every country and every product line.

Sadly, we are late arrivals to this increasingly aggressive international competition. For a wide variety of reasons, America's ability to compete in this global market has been threatened. There are at least three reasons to be concerned about the effect of our lagging efforts in environmental technology on our competitiveness. The first relates to the market for pollution control equipment. Public pressure and the demands of international trading partners are forcing many governments to take a far more aggressive approach to the control of pollution within their borders. The result is a rapidly expanding market for pollution controls.

America's engineers developed many of these technologies, but our businesses have been unable or unwilling to bring them to market. A good example is Selective Catalytic Reduction, a technology designed to eliminate NO_x emissions from stationary combustion sources. The catalyst which is the heart of selective catalytic reduction technology was developed by Corning

Incorporated, but sold to the Japanese because no market could be found in the United States. There is reason to believe that the advantage in control technology helps in some cases to give an advantage to the underlying manufacturing technology of the same nation.

The second reason for concern is that the emphasis on environmental technologies tends to lead to greater efficiency. Pollution is waste. Engineering to prevent pollution inevitably creates more efficient processes. Efficiency is an advantage.

The third reason for concern is that our products may be excluded from important markets if they are not environmentally sound. Indeed, as you know, this has become an important issue with respect to both the NAFTA and GATT. We already exclude certain banned products, and in the future our products will increasingly face similar barriers. Automobiles sold in Germany, for example, must be recyclable in compliance with that nation's "take back" law.

At the very least, we could regain control of our own market, which is still the world's largest. As matters now stand, the Selective Catalytic Reduction systems being sold in the U.S. are made in Japan. So are some of the fuel cells. Our largest manufacturer of solar cells is owned by a German conglomerate. We have only one surviving major manufacturer of wind turbines, and it is selling most of its units in Europe.

Perhaps the best indication of the market potential is the aggressive posture of our competitors. Neither the Japanese nor the Germans are given to flights of fancy, and they each have committed billions of dollars to the development and commercialization of the these technologies.

Perhaps most importantly, Germany and Japan--as well as Sweden, Switzerland, Austria and most other industrialized nations--support these technologies through their domestic environment and energy regulatory programs. Both Germany and Japan, for example, have air pollution limits for powerplants that are three or more times as stringent as those of the U.S. Similarly, energy prices in other nations much more accurately reflect the true costs of coal, oil and natural gas imposed on the environment. Sweden taxes pollution, while Germany requires preferential rates for electricity that is generated from sunlight or wind power. These policies assure that German and Japanese companies can perfect their technologies to serve domestic markets, then use their expertise to springboard into other countries.

We hope that these hearings represent the beginning of a movement to set America's environmental and technology policies in phase and in the same direction. Based on WRI's extensive work in this field we have both general and specific suggestions on how to accomplish this.

There are, in our judgment, seven specific initiatives that the new Congress and the new Administration could pursue to dramatically improve economic and environmental performance at home and to strengthen protection of the global environment. These are attached to the statement as Appendix A.

One WRI report, Backs to the Future: U.S. Government Policy Toward Environmentally Critical Technology by George R. Heaton, Robert Repetto, and Rodney Sobin, directly addresses the issues that are central to the hearing, so we ask that it be submitted in its entirety for the record.

Let me summarize our findings:

First, in the face of a population likely to double by the middle of the next century and worldwide demand for economic growth, only a massive transformation of today's products, processes and infrastructure through rapid and extensive technological change, can prevent environmental and economic disaster.

Second, national science and technology policies in the United States do not yet reflect the changed priorities arising from the end of the Cold War and the new salience of environmental issues, domestically and internationally. Priorities in the allocation of national R&D resources remain sharply skewed toward protection against armed threats and away from protection against environmental threats. This is true not only at a macro level -- for example, the funding balance between, say, defense and environmental R&D, but also in the details of the selection of particular technologies are "critical" to the nation, an exercise in which environmental factors have played much too minor a role.

Third, although private firms are selling all manner of "environmental" technologies, a public role is justified to underwrite the more basic technical knowledge that will be needed to solve the next generation of environmental problems and necessary to keep U.S. firms competitive. Although the United States has led historically in the development of environmental standards to combat environmental problems, other nations are forging ahead faster with the implementation of environmental technology policies to craft tomorrow's solutions.

The central concept in defining the role of government in this area is the notion of environmentally critical technology. There are four main issues that must be considered in developing a policy on environmentally critical technologies:

- how to define environmentally critical technology in a manner meaningful for public policy;
- which particular technologies may be termed "environmentally critical";
- what is the justification for and the appropriate form of governmental action supporting environmentally critical technologies;
- what kinds of policy mechanisms would effectively promote the development of new environmentally critical technologies.

Technological developments can be considered environmentally critical if:

- their use brings about large, cost-effective reduction in environmental risk;
- they embody a significant technological advance;
- they are generically applicable at the precompetitive stage; and
- their adoption involves a favorable ratio of social to private returns.

The main empirical research involved in our project was to apply these four criteria to the universe of technical developments on the horizon, using them as a sieve through which to identify a set of technologies that could legitimately be termed "environmentally critical." In many senses, this exercise resembles the focusing of R&D resources a public program to support environmental technology might engage in. Admittedly, it is a highly judgmental exercise.

Recognizing this, we based our research not only on our own analysis, but also on a thorough literature review and a wide-ranging series of interviews. The people we interviewed were technical experts, most of whom were currently engaged in technology development and chosen as a whole to give us a balance among technical fields and sectors -- industry, government, and academic institutions. We explored two main questions: what technologies should be included on the list, and how environmental factors were currently affecting the process of technology development.

Ultimately, we chose twelve areas of technology: energy capture, energy storage, energy end-use, agricultural biotechnology, alternative and precision agriculture, manufacturing modeling, monitoring and control, catalysis, separations, precision fabrication, materials, information, and contraception. (See Appendix B) Stepping back from these specific technologies, several general comments need to be made. First, the list should be seen as exemplary. It provides illustrations -- our judgments -- about what kinds of technologies might be considered environmentally critical, but it is by no means a "correct" list or the only list possible. Second, the technologies included on the list tend more toward broad technical areas than particular products, processes or techniques. This reflects our view that the most important technologies to be supported, at least from a public point of view, are "upstream" from commercial applicability. They open the door to broad systemic changes that reduce and prevent environmental problems rather than "end-of-pipe" solutions that have been overemphasized in environmental technology to date. Third, it will quickly be obvious to people following the discussion of "critical" technologies that our list of environmentally critical technologies resembles other, non-environmental lists to a significant extent. This overlap demonstrates an important point: that environmental concerns are part of the mainstream, not the periphery, of industrial technology development. Lastly, we should point out that our list is a first for the United States. Although some counterparts exist in other countries, to our knowledge nothing like this has yet been compiled here.

If a list of technologies such as this one begins to chart broad solutions to the nation's, and the world's, environmental problems, the obvious next question that arises is, "How do these technologies get developed?" The answer, equally obvious, is that most will arise from the private sector. There is still, however, a critical role for government to play in supporting the efforts of the private sector. We have considered the question of the government's role through exploration of deficiencies in the market for environmental technologies as well as a survey of public programs to support environmental technology development in the United States and other countries.

Among industrial firms with strong leadership and technical capabilities in the United States, there is clearly a vastly increased emphasis on environmental factors in technology development, coupled with a recognition of real economic opportunity: cost savings from more efficient, less polluting processes and profit potential from the burgeoning market demand for environmental goods and services. At the same time, there is considerable frustration, underinvestment, and inefficiency in the private sector R&D effort. The frustration arises from the lack of a long-term technical vision for the nation.

Furthermore, the benefits of new environmental technologies are often as much public as private. Industry's efforts, mostly focused on the near term, need to be directed and supplemented by publicly supported work on broader technical issues of generic importance. It is precisely in such areas that private underinvestment occurs: projects of fundamental, widespread importance whose results -- more akin to ideas than technologies -- firms cannot appropriate through intellectual property rights. This deficiency in private sector R&D investments is well accepted as a justification for public support for science. More recently, its applicability has been recognized for generic industrial technology. We have found it to be equally persuasive in the environmental context. Private sector R&D is often inefficient. Because many firms today face similar problems, private environmental R&D is needlessly duplicative. Pooling resources in cooperative R&D would make sense, particularly for small- and medium-sized firms. A government role here would be particularly valuable in providing a forum for cooperative R&D, contributing information and expertise and leveraging private funding through modest monetary support.

The regulatory system, which has supplied much of the impetus for the development of environmental technologies, now also restricts it. In trying to define, strict, clear and achievable standards we have developed a system that often requires or favors specific end-of-the-pipe pollution control technologies. Without sacrificing the structure of compliance that we have achieved, we need to build upon it to encourage the development of better approaches.

The programs that promote environmental technology in other countries must be viewed in the context of these nations' overall technology policies. In each of the five countries surveyed -- Japan, Germany, the Netherlands, Italy, and Canada -- the development of technologies to achieve national economic objectives is a matter of longstanding public policy. Government and industry usually see themselves as partners in efforts to improve national economic competitive position. Typically, policies identify broad technical areas within which government R&D funding supports the development of industrial technology, an approach that makes it easy to develop component environmental programs. Indeed, the assumption is widespread outside the United States that environmental technologies will become increasingly important in international economic competition.

All five countries have developed public programs that specifically target the development of environmentally critical technologies. A listing of these technologies appears in our report. Clearly, Japan is pursuing the development of environmental technology most vigorously, followed by Europe and then the United States.

Historically, of course, the United States led the way in the identification of environmental risks and the development of regulatory strategies to control them. As I have already noted, regulation can generate demand for environmental technology. U.S. science, too, has committed significant resources to the understanding of environmental issues. And indeed, many of our national technical institutions, labs and universities, are focusing increasingly on environmental issues.

Our main concern, however, is technology development, and in this respect the national effort is grossly inadequate. Even as late as 1991 five areas with little relevance to environmental technology -- defense, health, space, general science and energy -- accounted for 92 percent of public R&D. During the period of 1988 through 1991, R&D budgets relevant to the environment shifted away from applied research, which is closer to technology, and moved toward basic science. The environmental content in U.S. public policy other than regulation is diffuse and without coherence. Where it has surfaced, such as in the national list of critical technologies, it has been relegated to a distinct category rather than incorporated throughout.

Various policy options could be employed to remedy this situation. The following seven are good examples:

1. A Federal Institute for Civilian Technology which would fund R&D for environmental technology in private firms and/or public laboratories.
2. Cross-cutting environmental criteria in R&D funding across federal programs to augment the applicability of those programs to environmental issues.
3. New missions for the national laboratories in environmental technology development and transfer.
4. Federal support for cooperative R&D in industry and across sectors.
5. Major increases in international collaboration.
6. Regulatory reform to encourage technological innovation.
7. Immediate changes to ongoing technology support programs, like the Advanced Technology Program, to focus them more on environmental technology.

Each of these seven options has its virtues and drawbacks. Each could be developed further, modified or combined with others. Indeed, implementation of all seven at once would be a plausible scenario, since they are by no means mutually exclusive. The choices in this regard are detailed ones, best made in the course of the legislative process. Our concern is not so much which policy avenue is chosen but rather with the fulfillment of functions and purposes. More particularly, there needs to be a clear redirection of funding funding toward environmental R&D, a new institutional focus, coordination across environmental and technology policy, public-private cooperation in technology development, more market incentives and a reformulation of current regulatory and technology programs.

Thirty years ago governments helped to sponsor research on agricultural technology that created a "Green Revolution." The "Green Revolution" helped to avert starvation for millions of people as world population doubled. A second green revolution, a revolution in environmental technology to avert environmental catastrophe, should be the goal of U.S. technology policy. It will benefit the world and our economy.

Thank you Mr. Chairman and members of the Committee for this opportunity to present the results of some of our research, I would, of course, be happy to discuss these further in response to questions.

Appendix A

Improving U.S. Environmental and Economic Performance

Three basic tasks must be accomplished is the United States is to develop a coherent environmental technology policy. One is to remove environmental factors from the periphery, the second is to reform environmental regulation to make it an engine of technological change instead of a deterrent. The third is to use economic incentives to catalyze technology innovation.

To deal with these issues, the new Congress and the new Administration should:

- **Create a civilian technology agency to support research and development of critical technologies and make environmentally superior technology (EST) one of its priorities.** A new agency should be modeled as a civilian image of the Defense Advanced Research Agency (DARPA), incorporating the managerial and structural elements that have been key to DARPA's success.
- **Direct the Critical Technologies Institute (CTI) to develop a national strategy for environmental technology.** This strategy should include recommendations for identifying new programs; for improving agency coordination; for establishing new patterns of R&D cooperation, especially between the public and private sectors; and for reorienting ongoing R&D programs. An Environmental Coordinating Committee under the Office of Science and Technology Policy should be established to monitor and move forward on this national strategy.
- **Direct the most important civilian R&D programs – the Advanced Technology Program, the National Manufacturing Centers Program, the National Science Foundation Engineering Research Centers – to refocus their budget priorities by allocating at least 10 percent of their funds to environmental technology.** Increased funding would provide an immediate focus and emphasis on environmental technologies in these key research programs.
- **Establish and implement an environmental technology-export assistance initiative.** A new federal program should promote and expedite the export of environmentally superior technologies. This initiative would designate a lead agency to coordinate export-promotion programs; locate environmental market specialists in U.S. service abroad to identify new markets; and provide assistance to small and medium firms in exporting environmental technologies and services. "The Environmental Aid and Trade Act of 1992," introduced by Senators Biden, Wirth, and Gore, would require agencies to emphasize the exports of environmental goods and services.
- **Make environmental and commercial concerns major thrusts in the missions of the National Laboratories.** The substantial resources of the federal laboratories, comprising about one-sixth of the nation's technical personnel, could be key to the development of environmentally critical and energy-efficient technologies. The initiative should make more of the laboratories' activities pay-off commercially, especially through cooperative agreements with the private sector.
- **Stimulate investment in environmentally advantaged technologies.** The replacement of environmentally burdensome processes and products can be accelerated through carefully structured investment and R&D tax incentives. At the same time, economic and market initiatives that charge the full costs of pollution and energy inefficiencies would provide long-term incentives for investment in clean technologies. (See Initiative #2: Green Fees)
- **Direct the Environmental Protection Agency to propose changes in environmental regulations that would encourage and stimulate technology change.** (See Initiative #3: Regulatory Reform) Many environmental laws favor old technologies over new. Relying on end-of-pipe pollution controls has tended to entrench existing technologies at the expense of long-term innovation. Pollution prevention and waste reduction approaches would promote "upstream" solutions and encourage innovations in process and product design. Regulatory policy that would promote innovation includes:
    - performance based standards

- greater regulatory focus on pollution prevention and reduction
- increased and strengthened permit waiver procedures for new technologies, particularly for demonstration and testing projects; and
- amending the "grandfather clauses" that protect older, more polluting facilities from tough environmental requirements.

Appendix B
Environmentally Strategic Technologies

Technology	Risk Reduction	Technical Advance	Generic Precompetitive	Social/Private Return Ration
Energy Capture	+ +	+		+
Energy Storage	+	+	+	+
Energy End-Use	+ +			+ +
Agricultural Biotechnology	+	+ +		
Alternative & Precision Agriculture			+ +	+
Manufacturing Modeling, Monitoring, & Control	+	+	+ +	
Catalysis		+	+ +	
Separations	+	+	+ +	
Precision Fabrication			+ +	
Materials	+		+ +	
Information			+ +	+
Contraception	+ +	+		+ +

+	secondary importance
+ +	primary importance

Statement of Frank Popoff, Chairman, President, and CEO, The Dow Chemical Company

Mr. Chairman, Members of the Committee, I thank you for the opportunity to share my views this morning with this distinguished committee. I am Frank Popoff, Chairman, President and CEO of The Dow Chemical Company.

In addition to my brief remarks, I am submitting more detailed comments in my written testimony which directly respond to the issues you asked me to address today, and include a number of examples of Dow's pollution prevention efforts.

While the chemical industry faces all the issues of global competitiveness that confront our economy—trade, technology, education, regulation and tax to mention a few—we find ourselves center stage on issues relating to the environment. We feel that's good—we see ourselves as more a part of the solution than the problem.

The chemical industry is a high-tech, high-wage contributor to our economy as:

o A leader in exports with contributions approaching $45 billion in 1992, and a positive balance of trade close to $20 billion.

o A major player in investment spending with $37 billion invested in the industry's future last year.

o A research industry developing enabling technologies for customers and suppliers.

o A supporter of education, not only at the university level but more and more of math and science in grades K-12.

o And as a leader in environmental reform and technology.

We have always believed that the environment and the economy are inexorably linked and have long supported the concept of sustainable development.

Sustainable development says there can be no environmental reform without economic development and no economic development without environmental reform.

The theory of sustainable development is relatively simple—the practice is complex but some fundamental principles are emerging:

o First, we must establish clear environmental priorities based on sound science and risk assessment.

Not all issues are created equal and we must address them logically and on a global basis. Mr. Chairman, on this point we are in total agreement. In your statement during the confirmation hearing of EPA Administrator Carol Browner, you said we need to do a better job of setting priorities and focusing our efforts first on our most urgent problems. I especially agree with your call for a more efficient EPA that can substantially increase environmental protection while, at the same time, reducing unnecessary administrative and paperwork burdens.

o Second, we must make pollution prevention, rather than end-of-pipe treatment, our ultimate goal.

New technologies can and will be a force in waste minimization in existing processes and pollution prevention through new processes and products. At Dow, we have long understood the advantages of reducing waste at the source. In 1986 we formalized our pollution prevention efforts in a program called WRAP -- an acronym for Waste Reduction Always Pays. Our goals were simple and straightforward -- to reduce waste to the environment and do so cost-effectively. We've been successful on both fronts. I should also point out, however, that we spend significant environmental capital dollars on non cost-effective, regulatory-driven projects.

o Third, we must employ market initiatives to bring lasting solutions to environmental problems. We must begin to develop and employ full-cost accounting and full-cost pricing of our products based on complete life-cycle analysis, ensuring that the full cost, including environmental cost, is incorporated in our products. Then we will need to pass that full cost to the ultimate consumer so that he or she can decide to consume or not consume, based on full information free of hidden costs or subsidies.

In the aftermath of the Rio Earth Summit and the pursuit of the resolution of the issues of Agenda 21, a question arises:

Will we deal with:

- o Clean air
- o Clean water
- o Solid waste
- o Energy
- o Biodiversity and
- o Population

With command and control -- more legislation and regulation. Or, will we utilize market solutions developed in concert between government, industry and the environmental movement?

We are not saying we don't need laws and regulations. Our challenge is to make what we do have on the books more effective so that our laws and regulations result in real reform.

The new Administration has said it will join industry and responsible environmental groups in endorsing an end to the adversarial relationships that have marked the environmental agendas in the past and replace them with a dialogue committed to real reform.

In this dialogue, it is my belief that industry's call for incentives should be accompanied by an agreement to reduce disincentives.

Disincentives must be countered through reform:

- o Regulatory and administrative reform.
- o Financial reform.
- o An address to energy policy.
- o Tax reform.
- o Trade policy and practice.
- o Attention to accounting standards.
- o And, by all means, legal reform.

Industry, I'm convinced, is prepared to do its part to bring new technologies and new initiatives to the environmental scene around the world.

With a solid set of priorities and with the kind of dialogue and cooperation that are beginning to emerge, U.S. environmental leadership can be the driving force in sustainable development in this decade and the century ahead.

I would now like to offer comments on some of the specific issues the committee has asked me to address:

Development of environmental technologies

The foundation of environmentally sustainable growth is technology. Technological change and transformation are essential for the future quality of our global environment.

Perhaps the greatest opportunities for continued development of environmental technologies and environmental solutions are in the areas of pollution prevention, waste management and energy conservation.

If technological and economic considerations allow, as well as public policy requirements, the preferred method for managing wastes from industrial processes is through source reduction, which is one method of preventing pollution. To some, environmental technology may imply only replacement technologies and products for those we use today. But the reality facing us today is that not all processes/products are easily replaced. Incremental improvement of existing technologies is just as important as the development of new technologies and in most cases incremental improvements are more cost effective. All pollution prevention efforts have to be done on a prioritized basis in order to facilitate the wise use of limited resources.

In addition, environmental technologies are continually being developed to effectively manage the waste streams that are an inevitable part of the production process. This includes technologies that deal with wastes once they occur, such as efficient waste treatment facilities, as well as technology geared to restoring contaminated sites.

Dow has made waste reduction a priority at our facilities around the world. In 1986, we formalized our waste reduction efforts in the U.S. under a program called WRAP, which is an acronym for Waste Reduction Always Pays. The objectives of the program are to seek out projects that reduce waste to the environment, measure and track performance, and recognize employee excellence. The World Environment Center called WRAP "a model for industry" when it awarded Dow the 1989 Gold Medal for International Corporate Environmental Achievement. Through this initiative, we have undertaken hundreds of pollution prevention projects that have helped many of our processes reduce waste streams and, in many cases, directly reduce releases to the environment.

At one of Dow's agricultural products facilities in Pittsburgh, California, a team of employees identified opportunities to close-loop recycle and improve the control of a reactant used in the production process, which had previously been incinerated after a single use. After an extensive research effort to find the best way to recover and reuse the reactant, the team implemented permanent changes to the process. Due to this technology improvement, the process changes reduced the plant's consumption of fresh reactant by 80 percent and reduced waste that was previously incinerated by 2.5 million pounds per year. All of this translates to cost savings of well over $750,000.

At our latex production plant in Midland, Michigan, employees utilized quality performance tools to identify several different waste reduction opportunities within the process. They implemented several projects over a brief period of time, and significantly reduced waste and emissions. In one year, the plant's amount of waste sent to our on-site incinerator was reduced by 29 percent and the amount of waste sent to our on-site landfill was reduced by 60 percent. The efforts at this plant have saved $770,000 per year in yield improvements and internal waste treatment charges.

Another example of our pollution prevention efforts comes from our facility in Plaquemine, Louisiana, near Baton Rouge. When products were loaded into low pressure barges for shipping, the hydrocarbon vapors were displaced by the liquid product and released to the atmosphere. To prevent this from happening, a team of employees developed a system for recovering vapors from the barge vents and returning the vapors to the original production process for reuse. This project also resulted in a significant environmental benefit, reducing hydrocarbon emissions to the atmosphere by more than 100,000 pounds per year. However, unlike the previous two examples, the development of this source reduction project did not have a positive financial return on the investment.

These are a few of the many pollution prevention projects initiated at Dow in recent years and they illustrate how making changes to existing technology and equipment will get significant results. Not all investments in environmental technology will always yield positive financial results, but in some cases the environmental benefits justify the costs.

Dow is committed to pollution prevention as are many other companies. As the concept continues to gain momentum within industry, smaller firms that may not have sufficient resources find it a challenge to identify opportunities for pollution prevention. Through efforts like the Responsible Care initiative, the chemical industry has provided resources to other companies and industry groups for utilization in their pollution prevention efforts.

Historical contamination is another concern. One example of environmental remediation technology we've been able to develop is something called AquaDetox. This technology allows us to remove approximately 90 of the 114 priority organic compounds from groundwater, reducing up to 99.99 percent of the contamination. The technology was used at an aircraft manufacturing facility in Burbank, California, recently to clean up soil and groundwater contaminated with chlorinated solvents. Unlike most other groundwater remediation technologies, the closed-loop AquaDetox system produces virtually no air emissions. This was important at this site because local air pollution regulations tightly limit emissions.

Other areas in which environmental technology has been developed are in products and services, post-consumer waste streams and energy.

In Dow's Advanced Cleaning Systems business group, we have focused on developing alternative industrial cleaning products and services for users of chlorinated solvents. The intent of this technology is to help customers meet their environmental needs. We work with them to help them stay in line with regulatory requirements, and we're developing alternative products -- including water-based systems -- which are safe, effective and environmentally sound.

Another example of environmental technology geared to treatment of wastes is in Dow's Separation Systems business. Membranes developed and sold by Dow are being used in a number of environmentally related applications, including water treatment and desalination systems. The membranes are part of two new municipal systems in Southern California. This business, called FilmTec, also helped bring filtration membranes to the Gulf War and provided our troops with desalinated water.

Another example of a more environmentally sustainable technology is our conversion to a 100 percent carbon dioxide blowing agent for plastic foams production. Dow researchers developed and licensed a technology which uses CO2 instead of CFCs, to make things such as plastic foam cups. And because the technology uses CO2 that is produced in other processes or is naturally occurring, the process does not result in a net gain of carbon dioxide in the atmosphere. This is a technology which we now license worldwide.

Dow Plastics and a partner called, Advanced Environmental Recycling Technologies, Inc. (AERT) are working together to develop polyethylene recycling technology that economically removes contaminants such as food debris and paper -- including receipts from grocery sacks and labels from stretch film. When fully developed, the goal is that this state-of-the-art technology will provide the cleanest, most cost-effective recycled polyethylene film for large scale uses.

As a matter of interest, government played an important role in this effort. When AERT, headquartered in Arkansas, was getting off the ground, a state development grant approved by then-governor Bill Clinton combined with an investment by Dow allowed AERT to develop the technology into a commercial reality.

In some cases, industry needs the assistance of government for high-risk, high-resource development projects. Federal support through funding and other policies are important responsibilities over the next 10 years. Federal environmental and energy policy should be complimentary to industrial technology policy.

At Dow, we have an excellent example of a government/industry partnership that has resulted in an environmentally superb alternative to conventional coal-fired power generation that has now come to commercial fruition.

During the energy crisis of the early 1970s, Dow determined the need to develop a coal-gasification combined cycle process for use in its own extensive power generation systems. The Louisiana Gasification Technology, Inc., plant started up in April 1987 and was the culmination of nearly 20 years of research and development of the process. Related R&D costs and construction costs were paid entirely by Dow. In its role as a demonstration plant, the project was selected for a fuel-price guarantee from the Federal U.S. Synthetic Fuels Corporation in 1984. The guarantee paid the difference between the guaranteed price and the current market price of natural gas allowing for plant operation earlier than was economically feasible at the time.

Since that time the technology has been expanded and Dow has formed a wholly owned subsidiary called Destec Energy, Inc. The company develops, builds, owns and operates gas-fired cogeneration facilities that produce and sell electrical and thermal energy, as wells as facilities that manufacture synthetic fuel gas for use in energy production.

The next quantum leap (possibly doubling today's efficiency standards) will be the integration of fuel cells to the coal gasification process. This goal of developing integrated megawatt-scale fuel cells for superior power generation will require a level of effort, including funding from industry and government, similar to the development of coal gasification technology in order to reach commercial scale application in the next decade. Integration technology requires participation by many segments of U.S. industry and can be licensed to other nations. For successful technology development, this represents a perfect example of how government and industry could work together.

Eliminating and minimizing waste at its source or finding ways to recycle are ideal waste management methods. However, some amount of waste will still be created in all manufacturing processes and it's important that we continue to develop technology for efficiently treating those wastes.

Another example of technological advancements in the treatment of wastes is improved incineration technology. As might be imagined, incineration is not clearly understood and is sometimes feared by an increasingly environmentally aware public. It is the only available and proven technology which permanently and significantly reduces the volume, hazard and human health risks from organic hazardous wastes. Health and environmental risks from industrial wastes are practically eliminated through incineration. In fact, one of your colleagues from the House of Representatives, Rep. Bob Whittaker (R-KS), has said: "Proper incineration is an important form of treatment in that it greatly reduces volume and toxicity. Source reduction and recycling alone will never be enough."

These are all examples of some of the environmental technologies we've been pursuing. Many similar examples can be found at a number of other companies. At first glance, it may not appear that industry is aggressively working to develop new environmental technology. Hopefully, the examples mentioned above give an indication of the types of efforts that are underway.

Are all of these initiatives brought on by laws and regulations? Absolutely not. Are some of them? Of course. Perhaps the key driving factor in these efforts is the fact that the desired outcome is established, then industry is allowed to determine how best to reach that outcome. With this freedom to innovate, the technologies that result will be both environmentally and economically sustainable.

Benefits of developing environmental technologies

New technologies can impact all of our environmental challenges. The technologies described above are all aimed at achieving environmental benefits, such as cleaner water, less reliance on landfills, cleaning up groundwater contamination, lower emissions of greenhouse gases, increased energy efficiency and less non-renewable resource consumption.

Dow can point to some measurements over a period of time that illustrate direct environmental benefits. Many of the pollution prevention efforts and technology described earlier have helped Dow achieve a 32 percent reduction in emissions to the air, land and water from our plants in the U.S. since 1988. We're planning to achieve a 50 percent reduction by the end of 1995 and continued innovation in environmental technology will help get us there. In terms of energy use, new technology has allowed us to steadily improve energy efficiency over a period of time when our production increased dramatically.

Perhaps the greatest benefit of environmental technology is that it allows us to find cost-effective measures that result in true environmental improvements and reduction of risks, while resulting in economic benefits at the same time. Presently, Dow spends a large percentage of its environmental capital funds on compliance costs alone. This leaves very little for development of new environmental technology. When regulations permit us to spend more of those monies on technology, we will be able to pursue projects that have even more of a positive impact on the environment and that are economically beneficial.

The benefit to the U.S. economy and our international competitiveness seems clear. Through sustainable development, the balance of environmental reform and economic development, the U.S. can produce and export products with competitive advantages and environmental technology. It can also transfer technologies as appropriate to developing nations. This is already happening in the case of U.S. companies, such as Dow, that have foreign operations and transfer technologies to their own affiliates in order to achieve consistent environmental standards around the world. With sound environmental technologies being practiced on a world scale, the economic playing field will enjoy a degree of leveling by the deletion of environmental issues from the trade debate.

Key principles to developing environmental technologies

Although a lot of environmental innovation and technology has come about in recent years, there is much more untapped potential. Industry requires an end to disincentives more than it requires new incentives. While the conventional research and investment credits are highly appropriate, even more helpful would be reform in a number of key areas.

In order to speed up the process of developing environmental technologies, we must operate under certain key principles. These principles point out some of the barriers that hamper the development of environmental technologies. They include:

Prioritization

We must set environmental priorities. All issues are not created equal. In fact, those issues that happen to help people and the environment should probably take precedence. But regardless of how we value population, energy, climate, biodiversity, solid waste, clean air and water, wetlands and urban sprawl, we desperately need priorities and focus.

To fix those priorities:

We'll need to build broad consensus and real partnerships between disparate groups -- management, labor, government and the environmental community to mention a few, and dump the single-issue orientation and acrimony of the past.

o We'll need to harness good science and risk assessment in our review.

o Perhaps we'll need a National Environmental Forum and link it with its international counterparts.

o Acknowledgment that there are limited resources available.

Pollution prevention focus

We must make pollution prevention (versus end-of-the-pipe treatment) our ultimate goal. To do that, we must ensure that the polluter pays -- be they private citizens, business or government agencies, rather than pass on, postpone or duck the environmental impact of our actions -- and create new Superfunds in the process.

Regulatory and administrative reform

The U.S. is notoriously slow in approving new, safer and more efficacious agricultural products, pharmaceuticals and industrial chemicals, while often embodying an adversarial relationship between reviewer and petitioner. This is in sharp contrast to the more collegial attitude displayed in other parts of the world where both parties have a common interest in precipitating something good, rather than preventing any possibility of any risk whatsoever.

Some provisions in current environmental laws, such as the Resource Conservation and Recovery Act (RCRA), impose barriers to sound environmental and cost-efficient practices by industry. A recent submission to EPA by the Chemical Manufacturers Association (CMA) details a number of excellent examples of how RCRA impedes sound recycling. I am submitting those comments for the hearing record.

Also, another example of where we need regulatory reform in RCRA is the "mixture and derived from" rules. They result in the misallocation of scarce hazardous waste resources on low-risk waste, such as treatment residues, rather than devoting these resources to truly hazardous wastes. Also, current RCRA regulations often impede greatly needed remediation.

Financial and tax reform

Another principle to be considered in the pursuit of environmental technology is financial and tax reform -- not only as it relates to the cost of capital and our still-burgeoning deficit, but also to the fundamentals of our national, fiscal and monetary systems. In addition, we must adopt an enlightened address to specific tax issues such as simplification, double taxation on dividends and an investment tax credit. We should also come to the realization that we must tax consumption rather than investment and production, if we are to prosper through the creation of work.

Trade policy

Of all economies, ours should be the least likely to close its borders and excuse itself from international trade if, and only if, we level the playing field and remove our encumbrances.

Legal reform

We must figure out what to do about our inability to reform our tort system that generates an indirect tax on our consumers estimated at around $200 billion annually.

Reform accounting standards

Recently, newly added accounting standards have added more confusion than clarity and remain a competitive burden versus the standards of our trading partners.

Foreign investments

Environmental spending has important implications for the competitiveness of U.S.-based production that are often misunderstood. As you know, the United States is now spending well over 2 percent of its GDP for pollution abatement and control, well above the levels of other nations.

A recent survey by the Chemical Manufacturers Association indicates that about one-sixth (16.8 percent) of the capital expenditures of its member companies is for environmental purposes, more than is spent for new products (13.5 percent) or to improve efficiency in production (11.2 percent). Although environmental spending may be highly desirable for social reasons, in itself it does not make U.S.-based production more competitive compared to foreign producers. It is possible to cite many case examples where environmental spending has, in fact, improved efficiency and where the spending on a given project has contributed to a company's competitiveness. But more typically, environmental measures actually increase operating costs, including energy costs, and tend to reduce productivity. In fact, a recent CMA survey shows that for each $1 of environmental spending, only about ten to fifteen cents is recovered through improved efficiency. This, of course, does not argue that environmental spending should not be undertaken. It does, however, argue that environmental regulation and spending should be undertaken on their own merits -- not as a means to improved productivity and competitiveness.

You asked if foreign investments in the development of environmental technologies are adversely affecting U.S. competitiveness. I believe that your question also is directed toward U.S. industry's ability to compete in international markets in the sale of environmental equipment and technologies that stem from increased regulation and attention to the environment. I have heard it argued that tougher foreign regulatory standards than those imposed in the United States have resulted in foreign development of new technologies for air pollution reduction and that, as a result, "as much as 70 percent of the air pollution-control equipment sold in the U.S. today is produced by foreign companies." CMA has been unable to find any data supporting this assertion and its own analysis indicates that not only are imports equivalent to less than 10 percent of U.S. consumption but that the United States is a net exporter of air pollution control equipment.

In any event, although the markets for environmental equipment exports are important to pursue, they are relatively small. Also, environmental protection requirements will not fuel or even significantly enhance the U.S. economy or the development of jobs. Environmental measures should be undertaken on their own merits, not as a way to improve the competitiveness of U.S.-based production or as a means to force the development of technological edges that will lead to large export markets. Such actions would likely be counterproductive.

Small businesses

In order for small businesses to take advantage of environmental technologies, they will require the same types of reform mentioned previously. Market solutions serve small businesses and their ability to improve environmental performance. Command and control solutions do not.

Perhaps the biggest barrier to small businesses being able to employ environmental technologies is the tremendous administrative burden they face in complying with U.S. laws and regulations. Small companies are so inundated with paperwork and other administrative details, they do not have the time or resources necessary to assimilate new technologies into their operations. In short, our complex regulatory system has severely limited the ability of small businesses to develop innovative technologies. They also generally lack the financial resources and technical expertise of larger companies to progress in this area.

The chemical industry is working to address these barriers through a program developed by the Chemical Manufacturers Association (CMA) called Responsible Care. Responsible Care is a public commitment for continuous improvement in environmental, health and safety performance. Participants are obligated to follow ten Guiding Principles and six Codes of Management Practices: community awareness and emergency response, pollution prevention, process safety, distribution, employee health and safety, and product stewardship. As an indication of our industry's extensive commitment to this program, CMA member companies have voted to make participation in Responsible Care an obligation of membership in the association.

A key component of the program is for large companies to help smaller companies implement the codes and improve their performance. In 1992, the Synthetic Organic Chemical Manufacturers Association (SOCMA), a trade group mostly composed of small companies, became a partner association in the Responsible Care initiative.

Through Responsible Care's Mutual Assistance Program, a mechanism has been created to share ideas and resources among all companies in our industry -- large and small. To make up-to-date information available, CMA has designed a computer bulletin board for member companies. This provides data about training, technology and other Responsible Care-related information.

As part of Dow's commitment to this effort, we have published a catalog of environmental, health and safety resources that are available to other companies at no cost. Entitled "Industry Outreach: Dow's Environmental, Health and Safety Resources," the catalog briefly describes many of the programs, services, guidelines and other resources that are offered to other chemical companies and can be adapted for use in their operations.

Dow also is a sponsor of the American Institute of Chemical Engineers' Center for Waste Reduction Technologies (CWRT), a three-way partnership including industry, academia and government. CWRT is helping to facilitate the transfer of technology throughout all three sectors so that traditional approaches to pollution control, namely end-of-pipe treatment, give way to more efficient and environmentally beneficial technologies.

Mr. Chairman, my staff and I look forward to working with you and this committee as you continue to address these important issues.

STATEMENT OF DAVID CHITTICK, ENVIRONMENT AND SAFETY ENGINEERING VICE PRESIDENT, AT&T

Mr. Chairman, members of the Environment and Public Works Committee, good morning. My name is David Chittick, and I am the Environment and Safety Engineering Vice President for AT&T. I would like to thank you for the opportunity to testify here today. Mr. Chairman, I would also like to commend you for the foresight and vision you are demonstrating by holding this hearing. The integration of environmental considerations into the development of our technology and our economy will be a compelling challenge during the coming decades.

One thing I would like to achieve today is a common understanding of the nature of technology and environment. We in American industry are beginning a task which is among the most important, and complex, that we have ever attempted: the comprehensive integration of environmental considerations into every aspect of our design, manufacturing, and products. To do this will require entreprenurial ingenuity, flexibility, and rapid, continuing, innovation. It will require all of us - legislators, industrialists, regulators, the public - to move forward together; sharing ideas and concerns; fostering innovation.

In this testimony, I want to concentrate on three points. First, I will briefly explain the difference between what many people call "environmental technologies", and the far more comprehensive concepts I think we need to begin considering, such as "industrial ecology " and "Design for Environment" (DFE). Second, I will then provide several examples of how AT&T and others are beginning to explore, and in some cases implement, these broader concepts. Third, I will offer some suggestions for moving ahead in these areas.

Environmental Technologies, Industrial Ecology and Design for Environment.

As with any relatively new field, there is ambiguity surrounding the terms we use in this area. It is critical, however, to understand the difference between what are traditionally known as "environmental technologies", and what we mean when we talk about integrating environment into all technological activities.

Most people think of "environmental technologies" as "end-of-pipe" emission control technologies. These may be quite advanced, such as the Japanese research on algae that can consume large amounts of carbon dioxide. Still, they deal with controlling the environmental impacts of materials that have no further economic use - wastes. This is an important market, and technological innovation in this sector should be an important priority. It is, however, only one sector of our economy.

What we are talking about when we discuss industrial ecology and Design for Environment is very different. We are talking about restructuring the technological basis of our entire economy to make it sustainable over the long haul. We are not talking about devising better scrubbers; we are talking about recreating economic, legal and technical institutions, practices, and systems.

The new and still evolving field which looks at these issues is known as "industrial ecology." It may be defined as the systematic study of the interactions between the human economy in all its aspects and natural biological, chemical and physical systems at all scales. As applied to industry, "the concept of industrial ecology requires that an industrial system be viewed not in isolation from its surrounding systems, but in concert with them. It is a systems view of industrial operations in which one seeks to optimize the total materials cycle from virgin material, to finished material, to component, to product, to waste product, and to ultimate disposal. Factors to be optimized include resources, energy, and capital."[1]

There are two important implications of industrial ecology we need to bear in mind. First, it requires a comprehensive, systems-based, multidisciplinary approach. Our environmental problems are complex, and cannot be adequately addressed just by traditional, "environmental technologies." We need to change how materials, technologies, processes and products are thought of, designed, used, refurbished, or thrown away, not just control emissions better.

Second, industrial ecology requires a focus on technology, not just traditional control technologies, but the far more fundamental challenge of integrating environmental considerations into all technology and economic behavior. These new, more environmentally considerate technologies can help a growing global population increase its quality of life, while reducing the environmental impact of the concomitant economic activity.

By implication, our government needs to become more sophisticated in the way that technology is integrated into environmental decisions. As environmental regulation imposes costs which are an ever-greater component of GNP, and an ever-greater burden on industry, we need to assure that regulation is as efficient as possible. This is especially true where environmental regulation goes beyond "end-of-pipe" controls and begins to intrude into material and technology choice. The potential competitiveness implications of a wrong decision by an environmental regulator not well versed in the economics and technology of an industry can be significant. - as can the potential environmental costs. Unfortunately, there are some indication that other countries may be better at integrating technological considerations into their environmental regulatory structures than the U.S.[2]

Given that the field of industrial ecology is still very much an infant field of study, what should we be doing in the interim? It is obviously unacceptable to sit still until we work out all the theoretical details. We need to apply what we know to the decisions we must make now, in the best way we can. That's where Design for Environment comes in.

In general, Design for Environment can be defined as a methodology by which environmental considerations and constraints can be driven into product and process design activities. It helps firms internalize environmental factors. It is comprehensive, taking a systems approach to balancing and integrating environmental, technological, and economic factors in industrial operations. Importantly, it looks across the entire lifecycle of a product or process, not just at the manufacturing stage.

Why the focus on the design stage? Because that's where the environmental impacts of a product, process or service across its lifecycle are primarily determined. In the design stage, input materials and substances are chosen. The manufacturing technologies are at least implicitly selected. The maintenance requirements of the product are established. These choices of materials and how they are combined in components and subassemblies determines how easily the product may be recycled, or its impact on the environment if it is disposed of as waste.

Essentially, there are three stages to a Design for Environment analysis. First, the material, technology, process or product to be evaluated is selected. Second, the realistic options sets are defined. For example, for an evaluation of lead solder use in electronics, an option set might include lead solder, bismuth solder, indium solder, and a completely different technology, conductive epoxy (an epoxy matrix with conducting metal particles in it). Third, the environmental impacts of each option across its lifecycle are evaluated. Within the constraints which the manufacturing, competitive, legal and economic systems put on the options, a rational choice can then be made.

At this stage, unnecessary regulatory constraints on these choices will make it all that much harder to innovate, to select what might be an environmentally preferable option from a systems perspective. For example, for some minor specific uses of CFCs, the only available alternative AT&T could identify, at least in the short run, was chlorine gas. Chlorine gas is, of course, highly toxic, but we can engineer systems to prevent any exposure and, under the circumstances, phasing out CFCs was a higher priority. This option would not have been available to us had strict toxic use reduction regulations precluded it.

Let me emphasize here that we in industry are not doing this yet. We don't know how. We don't have all the tools. We don't have enough data. But we do have the vision. We do have the drive. And we are moving forward now.

Some Examples.

The confluence of technology and environment is rapidly accelerating. It may provide some idea of where we stand now to review some of the projects that are under way, in AT&T, in the electronics sector, and further afield.

1. The approach that AT&T has taken in its CFC substitution program is an example of the benefits of approaching environment/technology issues in a systematic manner. As you know, CFCs, used extensively in many applications in electronics, primarily as solvents, are being phased out under both U. S. law and the Montreal Protocol. AT&T could have simply substituted whatever was available and easiest, which in many cases would have been a chlorinated solvent. Instead, we stepped back from the details and asked ourselves what the technological option set was, and what was best for the environment, our products, and our customers. Based on that comprehensive review, we established a hierarchy of generic substitute technologies (listed in decending order of preferability):

1. Eliminate the cleaning step completely (through use of the AT&T Low Solids Fluxer technology, for instance).

2. Use a water-based cleaning system.

3. Use a hydrocarbon-based cleaning system.
4. Use a chlorinated solvent (only as a last resort, and to be phased out as soon as possible).
5. Ozone depleting substances are unacceptable.

This effort has been extremely successful: from 1986 to 1991, AT&T cut CFC emissions by 75 percent, while at the same time and as part of the same effort cutting chlorinated solvent emissions by over 80 percent. This effort, which was focused only on manufacturing, is in fact a successful example of systematic pollution prevention. Interestingly, however, virtually all the critical advances were to manufacturing technology, not what is traditionally considered "environmental technology." For example, in order to use water-based cleaning systems, it was necessary to redesign some components, such as open relays, which were compatible with chlorinated solvent systems so that they could "swim" in the aqueous bath. Manufacturing technology, not "environmental technology," was critical.

2. Based on information gathered through the American Electronics Association Design for Environment Task Force, it appears that companies are beginning to experiment with the implications of DFE in two generic ways: either by choosing a particular dimension of DFE, such as pollution prevention or product refurbishment, and focusing on that; or by selecting a product and attempting to evaluate its environmental impacts comprehensively. Obviously, experience gathered from both these approaches can be used to increase the sophistication and value of DFE methodologies.

Xerox provides an example of the first approach. They have a strong program in Design for Refurbishment, an approach to which their product line lends itself. This approach increases the useful life of their products and the components of their products, with obvious environmental advantages.

As an example of the latter approach, AT&T has initiated a product specific study involving a small business telephone. The purpose of the project is not to design a telephone we can unequivocally say is environmentally better than any other. In fact, we find we don't have the data to even know what that means at this point. Rather, we are looking at the product and trying to develop a scoring system which will tell us what's important, and whether we're getting better or not, at each lifecycle stage. Thus, for example, we're looking at how many plastic parts are used, and trying to make them from fewer types of plastics. We're also trying to label them. Both these steps make the phone easier to disassemble and recycle.

What we are finding is that this is a far more complicated task than we thought initially. Take some of the things we found when we looked at the manufacturing lifecycle stage. We find we don't have the data to understand what the cumulative environmental impact of some of the materials we choose may be. Also, a telephone includes a number of different components, many of which we get from different suppliers, frequently in different countries. They may use different manufacturing technologies, or handle their wastes differently. In many cases they regard this kind of information as proprietary, so they are not willing to give it to us. Complicating factors such as these make evaluating the environmental impact of the final product quite difficult.

3. Perhaps the most ambitious effort to evaluate the environmental impacts of a complex product is that hosted by the Microelectronics and Computer Technology Corporation (MCC). Supported by a large technical workshop held last summer, a study of the lifecycle environmental impacts of a computer workstation is scheduled to be released at a March meeting. This is undoubtedly a pathbreaking study, but even here the technical experts found significant unresolved data and methodological issues.

4. An example of the progress being made in the electronics industry as a whole is the American Electronics Association Design for Environment Task Force, which has created a package of White Papers dealing with specific aspects of Design for Environment, and how firms are trying to implement DFE practices. There are now seven White Papers in the series, with titles such as "DFE and Pollution Prevention," "Design for Materials Recyclability," and "Cultural and Organizational Issues Related to DFE."[3] More White Papers on other aspects of DFE, such as environmentally preferable packaging systems, are being prepared and should be out shortly.

These White Papers are not intended for technical audiences already knowledgeable in DFE. Rather, they are aimed at management and design personnel who are just beginning to consider the concept, wondering what DFE means and how to get started. Their purpose is to support the beginning of a broad competency in the American electronics industry in environmentally preferable design, manufacturing and operations, a competency which we view as critical to the future competitiveness of our sector.

5. In May, the IEEE (The Institute of Electrical and Electronics Engineers, Inc.) is planning the First International Symposium on Electronics and the Environment, with a strong focus on DFE. It is particularly noteworthy that the IEEE is a technological organization, not an environmental organization: the integration of technology and environment cannot occur if just environmental experts are involved. Technologists must embrace environment, and, at least in the electronics sector, that is beginning to happen.

6. It is also critical that continued progress be made in developing the concepts underlying DFE further, and that this be an international effort. It is thus noteworthy that the U.S. National Academy of Engineering is sponsoring a U.S.-Japan Bilateral Workshop on Technology and Environment in a few weeks, and is currently planning a multinational symposium on the same subject in early 1994. This follows a Workshop on Industrial Ecology and Design for Environment, attended by a number of

national and international experts, held by the Academy in the summer of 1992 (the papers from that meeting will be published by the National Academy Press sometime this summer).

7. These pioneering efforts are beginning to identify other pieces of the DFE puzzle that we need to think about. Thus, for example, the need to look at environmental impacts across the lifecycle of a product almost always requires gathering and evaluating data from many industry sectors, not just one. AT&T, for example, can try to design its products so that the number of different kinds of plastics used is minimized, and each part is marked. We cannot, however, determine what the cumulative environmental impact embodied in each type of plastic is. We don't have that expertise, the chemical sector does. Similarly, we don't know what the environmental impacts associated with mining and processing various metal ores are: that's the province of the mining companies. So perhaps one enabling tool for private firms that want to do DFE may be a mutually agreeable materials database.

Broader issues arise. For example, high efficiency light bulbs also contain mercury vapor - does society want energy efficiency, or reduced heavy metal loading of the environment? The highest temperature superconductor we have identified to date contains highly toxic thallium - again, assuming we can bring superconductor technology on line, are the energy reductions associated with superconductor use more important than discouraging toxics use? Will other countries take this same approach? How should risks be prioritized?

Recognizing that there may be a need to address such issues or, in other words, to try and think about what a "DFE infrastructure" might look for - industry and academic interests are arranging a meeting on this subject to be held March 26 at MIT. The purpose of the meeting is to identify a Planning Committee, which will presumably plan a workshop, which will then look at what a DFE infrastructure might include, and how one might begin developing one. The hope is that, as private firms begin to implement DFE in their operations, the tools that may be necessary for them to do so are also being developed.

There are a number of other efforts going on, but I think these are among the most interesting, and at least provide a flavor of where we are today. On the one hand, there is a lot going on, and the technical and industrial communities are increasingly becoming engaged by this supreme challenge. On the other hand, all these efforts are preliminary and tentative, more in the nature of experiments than anything else: not only do we not have answers, but in many ways we are still groping for the right questions. It is a time calling for innovation and flexibility; progress could easily be stifled by inappropriate public policies.

Public Policy Issues.

And that leads me to my last, brief comments about public policy in this area. What we need now is open communications and honest, continued experimentation - including regulators, academics, non-governmental environmental organizations, the public, and industry experts. We all need to be flexible at this point. There will undoubtedly be many things government can and should do - perhaps some of them will be identified as we consider DFE infrastructure issues more closely. Whatever we do, however, we need to be sure that we don't unnecessarily hinder the progress that is just beginning.

This raises the issue of the relationship between DFE and similar methodologies, and other environmental laws. I approach this subject with a high degree of caution - caution because I know that it can be so easily misconstrued or misstated. This hearing deals with the importance of creating a framework for the integration of environment and technology, but Congress will continue to create and revise the laws concerning the environment. In doing so, however, Congress should assess the consequences that various provisions may have on the ability or incentives for private firms to continue to integrate environmental considerations into their activities.

An example may make this clearer. The electronics industry is one which relies on some of the most advanced materials produced in the world for its component parts. While these are quite safe in the form in which they reach the customer, many of them have at some point in the manufacturing process required the use of chemicals or substances that are considered toxic. Moreover, many possible product and process technologies having substantial potential environmental benefits will require the use of toxics. Thus, for example, AT&T had to substitute chlorine gas for some of the processes for which it previously used CFCs, and many high temperature superconductors include highly toxic components such as thallium. Accordingly, while in general it is highly desirable to reduce unnecessary use or release of toxics, regulatory toxics use reduction programs can actually increase the lifecycle environmental costs of material choices, technologies, processes and products. They can also negatively affect the competitiveness of domestically-based manufacturing operations, which may be denied materials, processes and technologies available to their foreign competitors. It makes sense, therefore, to evaluate such programs to determine whether they impact the ability or incentives of private firms to implement environmentally preferable practices such as DFE, and, if so, whether the anticipated gain is worth the cost.

Environmental regulatory constraints are a part of doing business. But, we are becoming far smarter about the kinds of things we need to do to achieve real environmental progress, the kind we all hope can lead to a sustainable economy. We need to be careful not to extend inflexible, technologically unsophisticated, "command-and-control" environmental regulation to the point where it hinders our efforts to begin to evolve an environmentally sustainable economy, to maintain the competitiveness of private firms, and to support a healthy economy. Conversely, we need to develop policies that encourage the evolution and diffusion of environmentally preferable technologies, a particularly difficult task given that we cannot even identify such technologies yet.

In the interim, we all need to communicate better with each other, trying to avoid the adversarial posturing that has too often characterized this field in the past. Our new understanding of the complex linkages between technology and environment involves us all, and cannot be resolved by government, industry, or environmentalists acting alone. Mr. Chairman, I believe this hearing is a significant and noteworthy step in that direction, and I again congratulate you for the foresight you have displayed in seeking to explore these complex matters.

Footnotes:

1 T. Graedel and B. Allenby, Industrial Ecology, in press.

2 See, for example, Braden R. Allenby, Japan Trip Report for the National Academy of Engineering Technology and Environment Program, May, 1992; and Braden R. Allenby, Europe Trip Report for the National Academy of Engineering, November, 1992.

3 The White Papers and their authors/affiliations are "What is Design for Environment" (Brad Allenby, AT&T), "DFE and Pollution Prevention" (Brad Allenby, AT&T), "Design for Disassembly and Recyclability" (Robert Goessman, IBM), "Design for Environmentally Sound Processing" (Jan Sekutowski, AT&T), "Design for Materials Recyclability" (Walt Rosenberg, COMPAQ, and Betty Terry, Pitney Bowes), "Cultural and Organizational Issues Related to DFE" (Brad Allenby, AT&T), and "Design for Maintainability" (E. Thomas Morehouse, Jr., U.S. Air Force). Copies can be obtained from Theresa Pugh, Director for Environmental Affairs, American Electronics Association, at 202-682-9110.

DAVID CHITTICK
ENVIRONMENT AND SAFETY ENGINEERING VICE PRESIDENT, AT&T

ADDITIONAL WRITTEN COMMENTS PURSUANT TO ORAL TESTIMONY BEFORE THE SENATE ENVIRONMENT AND PUBLIC WORKS COMMITTEE

FEBRUARY 23, 1993

These additional written comments, expanding on my response to the question of possible implications of increased government funding of environmental technology R&D, are submitted as a supplement to my testimony of February 23, 1993, before the Senate Environment and Public Works Committee. I ask that they be included in written record of the hearings.

My comments at this point must be general, but I want to make one fundamental point: any analysis of the potential benefits - and drawbacks - of increased government funding of environmental technology, either as an independent program or through a consortium arrangement, depends critically on how "environmental technology" is defined.

At this time, the term appears to have two meanings. The first is the usual definition of "environmental technology" as traditional pollution control technology, such as scrubbers and contaminated soil cleanup technologies. The other is the far broader definition implied by Design for Environment (DFE): technologies which, although they may be introduced for a number of reasons by firms, have the effect of significantly reducing the environmental impacts of materials, technologies, processes, products or services throughout the economy.

If "environmental technology" is defined as pollution control equipment, then the benefits of a government-funded R&D program may be considerable for that sector. Such an investment, however, may not achieve the fundamental, systemic improvements in environmental performance across the economy which should be a principle goal of modern environmental management policy. Moreover, such a program might adversely affect the incentive structure faced by firms in other industrial sectors seeking to achieve improved environmental performance through pollution prevention and DFE methodologies. This would occur because such R&D would propagate the reliance, by both regulators and industry, on command-and-control implementation of "end-of-pipe" standards. It would create budgets, professionals, and contractors dependent on continuation of "end-of-pipe" programs. Moreover, if pollution control equipment is subsidized, it will cost less than it otherwise would, creating an incentive for companies to simply install such equipment, rather than investing in technologies which would reduce or eliminate the pollution to begin with.

This is a somewhat perverse incentive. Pollution control, after all, presupposes the existence of pollution, and the goal should be to eliminate the creation of pollution, not control it. In a certain sense, even though pollution control is an important, and large, market sector now, it should be seen as a transition sector, dependent on our society's current inability to implement technologies which are truly sustainable. Indeed, information presented at this hearing indicates that sales of air pollution control equipment have not increased substantially as a result of passage of the 1991 Clean Air Act Amendments, as many had anticipated. A major reason might be that a number of firms, such as AT&T, have developed and implemented technologies in their manufacturing operations which eliminate emissions to begin with. Thus, for example, AT&T has replaced a number of cleaning operations which previously depended on chlorinated hydrocarbons or chlorofluorocarbons (CFCs) with either "no clean" technologies, or cleaning systems based on water. Pollution has not been controlled, it has been designed out of the system. This should be, of course, a preferable result from a public policy perspective.

This is not to argue against government support of environmental technology R&D. Indeed, it is quite likely that at least in some areas - perhaps creating comprehensive materials databases including risk assessment weighting factors, or supporting the development of uniform international environmental practices and standards regarding materials regulation and choice, or developing "green procurement standards" - government support will be critical. It may even be that carefully targeted programs involving new "control" technologies are warranted. In each event, however, it should be required that the proposed support be tested to ensure that it creates incentives - or at the least, does not create disincentives - for private firms across the economy, using methodologies such as DFE, to research, design, and implement environmentally preferable practices, technologies, products, processes and services.

In sum, a truly effective government environmental technologies R&D program depends critically on adopting a broad definition of "environmental technologies," one that goes beyond any individual industrial sector. As with any environmental regulatory initiative, however, such a program should be evaluated in light of the incentives or disincentives it creates for private sector implementation of Design for Environment and similar comprehensive, systems-based environmental methodologies.

Statement of Daniel S. Greenbaum, Commissioner, Massachusetts Department of Environmental Protection

Mr. Chairman and members of the Committee, thank you for the opportunity to testify before you. My name is Dan Greenbaum, and I am the Commissioner of the Massachusetts Department of Environmental Protection. I would like to share with you today our experience in strengthening environmental protection in Massachusetts while at the same time removing the regulatory roadblocks to the development of innovative environmental technologies.

I applaud the Committee's commitment to environmental technologies. The development of environmental technology is critical to the nation's environmental and economic future. Only through technological innovation and creativity will we solve our environmental problems; and in applying new technologies we can both build a vibrant new sector of our economy and improve the global competitiveness of all American industry.

In Massachusetts alone, the environmental technology industry comprises over 450 companies, employing 36,500 people, with total annual sales greater than $5.2 billion. Even in a slow economy the industry has been growing at a 5% annual rate; and growth is expected to accelerate in this decade. This emerging envirotech industry is on the job today, finding solutions to air and water pollution problems, to the reduction of solid and hazardous waste at the source, and to the cleanup of over 100 years of hazardous waste contamination. This industry has been aided in Massachusetts by the development of the first Enviromental Business Council in the nation, which is actively promoting business partnerships, and international markets, for environmental technology

Take, for example, the small company of CERAMEM, in Waltham, Massachusetts. This company has adapted ceramic filter technology first developed for aerospace application to a range of critical applications to reduce air and water pollution. The company has patented and is now marketing successfully a series of ceramic - membranes which can control, at competitive cost, very fine particulate emissions from everything ranging from a factory to a diesel locomotive. Company founders are already finding a substantial national and international market.

There is much that we as a nation can do and have done to encourage the development of environmental technologies. We can provide technical assistance to companies to alert them to emerging technologies. We can provide tax incentives for the development of new technologies. We can make envirotech a centerpiece of growth strategies for export markets, as Massachusetts has done.

There is probably no action we can take, however, that will do more to promote environmental technology than to redesign environmental protection efforts to:

o First, provide strong, clear standards for reducing or eliminating pollution;

o Second, eliminate confusing, duplicative programs that freeze in place existing environmental technology, at the expense of innovation; and

o Third, focus principally on pollution prevention, which can most effectively improve the environmental performance, the efficiency, and the competitiveness of American industry.

Clear, strong environmental standards are the single greatest reason that the United States has the substantial envirotech industry it has today, and the reason that in many areas of pollution control, the United States is the international leader. We have watched in recent years, however, as stringent new requirements in Germany and Japan, particularly in air quality, have given these countries the competitve edge for the most cost-effective air pollution control technolgies. In this light, we should view the new tougher standards emerging from the Clean Air Act of 1990 not only for the health and environmental benefits they will bring, but for the push they will give to help American industry regain a position of world leadership.

Tough environmental standards will not, however, encourage the development of environmental technology if they are implemented through the often complex, fractured, and confusing system through which we deliver environmental protection today. In fact, the confusion caused by duplicative environmental agencies and programs may have exactly the opposite effect, causing businesses faced with multiple and conflicting requirements to choose to implement the least innovative, and often the least effective technologies, or worse, to do nothing at all.

Take, for example, the way environmental agencies conduct industrial inspections to assure compliance. In nearly every state in the nation, and within USEPA, inspectors operate in independent teams focussing solely on air pollution, or water pollution, or the safe management of haaardous waste. Separate inspectors often visit the same factory at different times during the same year, looking for different environmental problems, giving different directions, and seeking solutions one pipe or one smokestack at a time. The result is confusion for the company, pollution being "pushed around" from the air to the water to the land, and no focus on developing the most cost-effective technologies to reduce pollution at the source in the first place.

In 1990, Massachusetts initiated the Blackstone project, to overhaul the entire way inspections are done. The Department of Environmental Protection retrained our inspectors who were visiting electroplating companies in the Blackstone River Valley near

Worcester, Massachusetts. They were no longer to look at a factory one pipe or one smokestack at a time, but to look at the whole factory, to send one clear and consistent environmental message to business owners, and to focus on encouraging the companies to install technologies which reduce toxics used at the source, to prevent pollution before it happens.

The results were impressive. The same number of staff could do 25% more inspections, the companies were pleased to have all of their questions answered at one time, and nearly 6 out of 7 companies inspected installed new pollution prevention techniques or technologies. The program has now been expanded statewide, with the interest and support of USEPA, and it has been renamed Waste Prevention FIRST (for Facilitywide Inspections to Reduce Sources of Toxics). Rather than confusing and discouraging companies, we are now, with the help of the separate state Office of Technical Assistance, fostering the installation of a wide range of innovative environmental technologies, at even some of the smallest businesses in the state.

We have, at the same time, included new incentives in our rules for companies to receive faster reviews, or other benefits, by taking the initiative to install prevention technologies. When the Polaroid Corporation sought to expand and renovate a film manufacturing facility in New Bedford, Massachusetts, they became the first company in Massachusetts to benefit from the environmental waiver program enacted into law in the Massachusetts Toxic Use Reduction Act of 1989. They qualified for this waiver, which gave them a streanilined approval process cutting months off the time to get construction underway, by redesigning their entire film-making process to eliminate entirely the use of silver nitrate, sulfuric acid, methanol, and other chemicals, and installing technology to reduce the use of the toxic solvents by between 89% and 99%.

In the long run, the most effective way to promote environmental technologies and improve the competitiveness of American business, will be to redesign all environmental protection programs to focus first, and principally, on pollution prevention. While end-of-the-pipe control technologies have been, and will continue to be, an important part of environmental technology, and of the nation's environmental protection efforts, only efforts which focus increasingly on pollution prevention techniques and technologies will expand the envirotech industry, cut down on waste treatment and disposal costs, and improve productivity while eliminating or reducing many sources of pollution.

The environmental rules we have developed have to be changed to accomplish this. In 1988, Massachusetts began reviewing every new environmental regulation to ensure that maximum incentives for source reduction were always incorporated. last year, USEPA launched the Source Reduction Review Project, an ambitious effort to scrutinize all of the rules which affect a particular toxics-using industry to simplify the rules, remove obstacles, and build in incentives for prevention. Similarly, USEPA last fall issued guidance which actually encourage states like Massachusetts to invest in pollution prevention initiatives like the Blackstone Project. These efforts, spearheaded by the Pollution Prevention Policy Staff in the Office of the Administrator, are heartening signs of new ways to do business at EPA which will improve environmental protection and foster an explosion of innovative environmental technologies. I would urge the Committee to support these initiatives, and to view them as a critical component of any strategy you develop to promote environmental technology.

The challenge before us is enormous. To foster the greatest diversity and intensity of environmental technology development, we need to to do nothing short of retooling the way we do the environmental business of the nation:

- to ensure clear, strong standards;
- to eliminate confusion and duplication; and
- to focus principally, and increasingly, on pollution prevention.

The rewards are equally great. With the right set of protection standards, and incentives for prevention, we can inspire a vibrant new sector of the economy which, while reducing and eliminating pollution, is adding jobs, improving American competitveness, and regaining leadership for the nation in the international environmental marketplace.

Thank you for the opportunity to share these thoughts with you. I have provided the Committee's staff with detailed documents describing some of the technologies and intitiatives I have touched on here today, and stand ready to assist the Committee in any way I can as it moves forward to lead the way toward enlightened development of environmental technologies for the 21st century.

Statement of Donald A. Deieso, Ph.D., Executive Vice President,
Air and Water Technologies Corporation, Branchburg, New Jersey

ENVIRONMENTAL TECHNOLOGIES: CURRENT DEVELOPMENTS & ISSUES

INTRODUCTION

Ladies and gentlemen, my name is Donald A. Deieso. I am Executive Vice President of Air & Water Technologies Corporation (AWT). I greatly appreciate the opportunity to appear before this Committee today to speak about current developments and issues regarding environmental technologies.

Let me first describe quickly the vantage point from which I speak. Air & Water Technologies is the parent of the Research-Cottrell and Metcalf & Eddy companies, respectively the oldest and largest air and water pollution control equipment and engineering firms in the U.S. As Executive Vice President, I direct the day-to-day operations of all of AWT's subsidiaries. Our operations are international in scope: AWT owns or is a partner in pollution control ventures in Europe and the Far and Middle East, as well as in North America. We offer a full range of environmental technologies and services to these markets, including design, engineering, construction, service and maintenance, and consulting services, through 94 offices with 4,000 employees. I also serve as President and Chief Executive Officer of the Research-Cottrell Companies.

My previous experience includes service as a State environmental commissioner, as head of one of the U.S. Environmental Protection Agency's regional Superfund programs, and as manager of environmental services and compliance for a major U.S. public utility. In these capacities, I have been either an environmental regulator or one of the regulated. Today, I am in a unique position: I help the regulated to comply with the regulators. To meet the goals of both parties, I supervise the development of the most effective and efficient environmental technologies and services available for domestic and overseas markets.

One other very recent experience has contributed significantly to my views on how government can help or hinder the achievement of sound environmental goals and the healthy development of environmental markets. I serve on the Environmental Protection Agency's Clean Air Act Advisory Committee, with a number of other representatives of large and small American businesses and industries, as well as State government officials. During our meetings over the course of the past two years, the sense of frustration on the part of Committee members has become palpable. We have pleaded for the proposal and promulgation of regulations -- mandated by the Act itself -- to implement its provisions. A majority of those regulations spelling out the requirements for industrial compliance have languished -- not in EPA, but at the Office of Management and Budget and the Council on Competitiveness. Without the guidance of proposals or final regulations, the industries have not known what to do, what controls to adopt, what capital to spend. Business and industry representatives on the Committee have been among the most vocal in criticizing this delinquency.

Let me underscore the point that these serious delays cannot fairly be laid at EPA's door. In fact, at times I felt somewhat sorry for the unfortunate EPA staff members who had to listen to our criticism. They knew, as did we, that they had worked diligently to draft the regulations, and the subsequent issuance was beyond their control. I can only hope -- and I believe that I can in fact speak for a majority of the Clean Air Act Committee members on this subject -- that the Executive Branch will now move rapidly to comply with the law, and that Congress will exercise diligence through its oversight powers to bolster EPA's resolve to get the job done. Implementing the law will be good for the environment, good for the economy, and good for the environmental industry.

In proceeding, I would like to share with you, in capsule form, some observations about the "State of the State" of the U.S. environmental industry today, particularly concerning its financial health in our domestic economy, its competitive position overseas, and some measures the members of this Committee may want to consider as you address the issues and bills that will come before you in this 103rd Congressional session. For the record, I am submitting a supplemental written statement that responds briefly to each of the seven questions you have posed for this hearing.

SUMMARY STATEMENT

Contrary to many previously held views, the environmental industry has been seriously affected by the recent recession. Once considered "recession-proof" or "recession-resistant," environmental industry earnings have been adversely affected -- to the degree that many firms are posting record losses, some are going out of business, and others are diversifying into other businesses.

As a specific example, this Committee heard months of testimony on the financial impacts of the Clean Air Act Amendments of 1990 on the regulated community. I personally heard the affected industries share estimates of incremental costs of compliance of $10 - $25 billion annually. I would like to report to you that now, 28 months after the passage of the CAAA, the U.S. air pollution control market was smaller in 1992 than it was in 1991, and these levels are as small as they have been for the past ten years. In short, there has been no real market impact from the Act -- leaving us free to speculate on the reasons.

Further, despite Commerce Department estimates and market studies which indicate national environmental expenditures of $80 billion annually, the sum of the revenues from the major environmental firms do not even approach that amount. While it is true that expenditures for compliance include internal operating expenses of regulated facilities, it is clear that environmental expenditures made by the regulated community are overstated.

As a result, many U.S. environmental firms have been pursuing off-shore markets for many years. Faced with the need to demonstrate earnings growth and recognizing the dwindling environmental market in the 1980s, firms such as ours opened offices in Europe, the Pacific Rim, Central and South America, as well as in Canada and Mexico. Today, supplying environmental technology to developed and developing nations represents 20-35 percent of our revenues.

It is important to note that our technology and engineering are quite competitive with technology from other nations. In fact, we lead the world in many of the facets of environmental technology. Let me be clear, engineers and scientists have been working longer on environmental matters in the U.S. than in any other country.

SUPPLEMENTAL WRITTEN STATEMENT

I.

What types of environmental technologies are being developed in your area of expertise? Are they being developed in response to laws and regulations or for other reasons?

As the Committee's invitation noted, environmental technologies fall into two main categories, process modifications or "end-of-pipe." Each has costs and advantages, and both are needed to satisfy environmental quality and business productivity concerns.

Traditional technologies for controlling air and water pollution are undergoing some exciting modifications. In the air field, methods have been developed -- and successfully applied commercially -- for improving the performance of the electrostatic precipitator (ESP), long a staple device for capturing solid particles that would otherwise be emitted to the atmosphere as pollutants. Some of these improvements include physical changes such as longer plates (collecting surfaces), wider plate spacing, and improved electrical and mechanical control systems. Chemical modifications include humidification, injection of sorbent materials downstream of the ESP, and geometric modifications to the precipitator internals to improve capture efficiency for collecting fine particles (PM_{10}). Our technology is accepted worldwide; in fact, in China, an electrostatic precipitator is known as a "Cottrell" -- after Frederick Cottrell, the father of our company, who invented the commercial precipitator in 1907.

In water, the environmental industry has added to our conventional primary and secondary treatment technologies such advanced or "tertiary" methods as denitrification, ozonation, and diatomaceous earth filtration. In addition to these technologies, our firm and other U.S. industry leaders have experience and expertise in such in-demand technologies for the developing world as desalinization.

Throughout the environmental industry, traditional technologies such as scrubbers and baghouses are being enhanced through the incorporation, for example, of new catalytic materials and synthetic fabrics that serve as filters or collectors. Some of the most promising technologies currently under development are what I might term "crossover" technologies, in that they have applicability across the traditional air, water and soil media. These include such chemical and physical processes as biofiltration and osmosis, in which membranes -- sometimes of exotic materials -- or living organisms are used to filter or to "eat" substances that contaminate air flows, drinking water supplies, or industrial and municipal wastewater streams. Such technological enhancements are being pursued in our universities and in the laboratories of businesses like ours; today's technical literature abounds with carefully peer-reviewed articles describing exciting advances and possibilities.

To your query about the forces compelling such advances -- laws and regulations or other "drivers" -- I would answer "both." Environmental regulation is clearly a hammer, as the regulated community is motivated to seek more efficient and cost-effective ways of meeting emission standards and limitations. But purely commercial or business interests also foster technological advances. The need in the chemical and pharmaceutical industries for ultrapure water, for example, is fueling the commercial development of improved purification technologies which, in turn, may result in new applications for municipal and industrial pollution control systems. Similarly, new ceramic and metallic alloys developed for government and private space or oceanic programs may have as-yet-unforeseen uses for air and water clean-up purposes.

Having stated that commercial motives alone do account for the development of some techno-logical advances, let me make it clear that this stimulus alone cannot produce the impetus needed to keep the U.S. foremost in technological environmental leadership. Strong laws and regulatory programs, with a vigorous enforcement component, are the primary driver for those numerous companies that do not need to develop new environmentally applicable technologies to compete successfully in their own markets. Many of these firms are, indeed, "good neighbors" in their own communities and strive to comply with -- or even go beyond -- minimum environmental standards. But these good corporate citizens need strong governmental enforcement programs, to assure that their less scrupulous competitors meet minimum standards at the least, so that the latter gain no unfair competitive advantage by avoiding environmental compliance expenditures.

II.

What are some of the environmental benefits which could accrue from these technologies and what are the potential benefits to the U.S. economy and our international competitiveness?

I will not cite today, in support of efforts to restore and maintain environmental quality, such classical --and, I believe, valid -- benefits of a clean environment as are inherent in terms like "public health and welfare." These and other phrases like "quality of life" and "better standard of living" may have something of a hollow ring, invoked as they are by environmental zealots or by NIMBY (not-in-my-back-yard) interests. [And even otherwise admirable politicians have resorted to wrapping themselves in the cloak of environmental rhetoric in NIMEY (not-in-my-election-year) situations, supporting measures that appeal to the NIMBYist that lurks in far too many of us. I hasten to add, of course, that no one on this Committee has ever been known to do this.]

Likewise, the numerical conjurings of certain economists, who torture numbers to "prove" that any but the mildest environmental requirements will stifle the national economy or wildly cost or tax the "family-of-four," ring more than a little absurd. If such arguments were heeded, miners would still be carrying canaries into mineshafts.

But no sensible person I have ever met truly believes that there is no value to enhancing life's quality, to maintaining or restoring the quality of our air, water and soil, once basic requirements for food, shelter, and other necessities have been met. Nor, despite the sometimes troubling dilemmas that technological advances may bring -- witness the ethical problems created by new medical technologies -- do sensible people passionately hold that our world would be a better place if our modern industrialized society, with all its man-made substances, products and inevitable by-products, had never evolved.

Leaving aside speculative numerical arguments, then, I offer a "values-oriented" economic response, grounded on realities and experience that non-economists and non-scientists see and understand in daily life. A healthier workforce, not sickened by asthma induced by air pollution or water-borne illnesses, can produce more goods and services, more efficiently and at a lower cost to employers in lost time, medical premiums, and illness-induced errors at work. New materials, production line modifications, development and substitution of less harmful product components, and recovery and reuse of raw materials result in lower costs, higher production rates and greater profits for manufacturers. Newer manufacturing equipment yields less expensive goods, at more efficient energy levels, and lower operating costs than older, less efficient, more polluting production processes. Experience and intuition tell us such progression is real; experts can quantify it, and I happily leave it to them to do so.

Having yielded to others to document the environmental benefits resulting from the application of first-rate air and water pollution control technologies, let me describe some potential economic benefits. The U.S. Environmental Protection Agency has estimated that every $500 million dollars spent on air or water pollution control creates over 10,000 new jobs in this country. The international market for environmental products and services is over $200 billion at this time, according to the OECD. U.S. firms have about 40 percent of that market, according to the Department of Commerce. And we have not yet really tapped into markets, such as Eastern Europe, where gigantic needs exist but there are no economic resources to meet them.

III.

Describe some of the principal barriers (e.g., legal, regulatory, institutional, lack of resources), if any, to further development of these environmental technologies?

The most serious barrier that exists is the lack of a strong marketplace. There are four components to the development of a healthy, vigorous market: 1) strong laws and regulations, 2) a general will on the part of the regulated community to comply with the spirit as well as the letter of the law, 3) a strong enforcement program to assure that renegade competitors cannot gain an unfair market advantage by avoiding the costs of compliance, and 4) a healthy national economy. Take away or weaken any one of these elements, and the market falters.

The lack or relative weakness of some of these elements has, I believe, hampered the U.S. environmental industry in recent years. We basically have strong laws -- even though each of us can identify various flaws -- but bogged-down regulatory and enforcement programs have undercut their implementation. By and large, the regulated community is willing to comply -- if they only knew what is going to be expected of them so that they can plan wisely and invest capital with some assurance that the expenditures will satisfy compliance requirements. And those who are reluctant to comply are too often able to avoid or push back deadlines: they simply go to a judge and plead "We didn't have sufficient time after the regulation was finally issued -- but, look, here's our new plan and schedule; we'll only be two years late."

Finally, the environmental industry has, like other business segments, been adversely affected by the lack of a healthy domestic economy. The single most beneficial contribution this Committee can make is to help assure that EPA has the resources to do its job -- and then exercise its oversight power to bolster the Agency's efforts. The single most beneficial contribution that the Congress as a whole could make to the environmental industry, and every other major segment of the U.S. business community, is to help get our economy back on track.

IV.

What steps could be taken to reduce these barriers and promote new research and development of commercially available environmental technologies (e.g., by industries, State or Federal governments)?

One step that almost certainly can only be undertaken by the Federal government, because of its magnitude, is creation of and support for research and development efforts that are too massive for any individual business or business segment to support on its own. The Clean Coal Technologies program is one such example. For the foreseeable future, coal will be king among fuels for most of the world, and this fact is the most compelling argument I know for finding ways to burn it cleanly.

Another critical contribution -- which, again, needs Federal leadership to make it truly workable and productive -- is a reliance wherever possible on market incentives to encourage and reward the development of innovative compliance strategies and technologies. The business industry in general, as well as our environmental sector, needs flexibility to try new approaches, to take risks: risks with capital and risks with technological advances. In this regard, the allowance trading provisions in the 1990 Clean Air Act represent a major step forward, and this Committee deserves a great measure of commendation for shepherding this departure from the command-and-control philosophy we have been living with for years.

V.

Describe some of the financial investments you have made in the development of new and innovative, commercially available environmental technologies?

I want to describe just one such investment today, because I think there are some valuable lessons in its outcome. In 1987, Research-Cottrell acquired the Teller scrubber system, with the 50 or so patents that pertain to it. This technology is particularly exciting because of its ability to remove a number of pollutants simultaneously, including sulfur dioxide and such acid gases as hydrochloric and hydrofluoric acid, as well as some hard-to-control metallic compounds like mercury and cadmium, and the organic dioxins and furans which are of so much public health concern. This technology has other advantages: it accepts variations in the composition and properties of the incoming flue gas, it produces a dry end-product, and it is easy to operate and maintain. It can be retrofitted on existing installations or incorporated in greenfield facilities. A technological winner, it would appear.

How has this technology fared in the marketplace? Very well abroad, and not as well at home. The Teller system is uniquely suited for controlling emissions from municipal incinerators and waste-to-energy facilities. For this reason, it has won tremendous success in Japan, where landfill space is nearly non-existent and nearly every source of energy is welcome. In fact, the success of this technology in this market -- in such industrial applications as glass and secondary nonferrous metals facilities as well as in combustion control -- has motivated us to enter into a joint venture in Japan to further market this technology and other U.S. air and water pollution control systems. This, in a country where environmental restrictions on air emissions are much more stringent than in the U.S.

Why hasn't such a proven, beneficial technology fared as well in this country? For one reason, in a potentially major market -- waste-to-energy -- regulations for emissions are only beginning to be proposed. Many other industrial facilities are only now becoming subject to more stringent emission limitations, often of State origin rather than Federal.

And everywhere, it seems, legislators, regulators and other public officials come face-to-face with the dreaded NIMBY monster whenever it is proposed to site a new facility or retrofit controls on an existing one rather than close it. While today's hearing is not focused on the NIMBY phenomenon, I do want to point out that its existence is often a sad reflection on the state of our nation's scientific literacy -- not just among the public in general but also among our media and even members of the scientific community from whom better should be expected.

My experience with this particular technology is, unfortunately, not unique. Many of my colleagues in the environmental industry have their own direct experience with promising technological innovations that languish, not because of their riskiness or expense, but simply because a reluctant government has not established a regulatory floor that would invigorate a market. The movie "Field of Dreams" has a wonderful line -- "Build it, and they will come" -- but I have not found that shareholders, banks, or the investment community give great credence to this sentence as an operating philosophy.

VI.

Have foreign investments in the development of environmental technologies adversely affected U.S. competitiveness in this market area to date, and do you expect that such foreign investment will affect our competitiveness in the future?

Let me begin with a caution here: I sometimes wonder how to define a "U.S. firm" in today's global economy. International conglomerates -- among them companies unarguably American in their origin -- are a fact of life in today's technology markets. Many of my company's direct competitors are now owned, in whole or part, by "parents" that are European or Pacific in origin. And, as mentioned previously, we are active as parents or sole owners in overseas subsidiaries.

I strongly believe that there is nothing inherently harmful in this trend to globalization -- but I also believe that there can indeed be a downside. Like it or not, international markets do not provide the semi-mythical "level playing field." Many central governments in other countries furnish special marketing supports to technology firms that are of national origin, even if they have evolved into multinationals. Wherever American air pollution control manufacturers go, we can expect to compete with firms of other national origin.

And, far too often for our comfort, we find that -- even where a client actually prefers American technology -- we lose the competition on other grounds. For example, it is fairly common for governments in some industrialized countries to offer special financing to underwrite technology exports. U.S. firms also offer financing packages to overseas clients, but our funding sources are generally foreign commercial banks. These banks are in business to make profits from their loans, not to underwrite U.S. exports, so the interest and other financial terms we can obtain and offer cannot match those from our overseas competitors. And, if you agree that it would be desirable for our industry to be able to match this type of competition, then it may be useful for this Committee to examine the way the U.S. government allocates its own funding support for environmental technology. There are several recent examples of U.S. government financing being used to support overseas technologies -- not just overseas, but here in the United

States.

Let me emphasize that I am not arguing for protectionist policies. I do not believe that we should prohibit or even discourage the application of technologies that originate abroad. Nor do I believe that we have any innate disadvantage in competing with such technological advances. American science, engineering and ingenuity are excellent; we can compete fairly with anyone. The U.S. environmental industry does not need to be protected, but it does need to be fairly supported.

VII.

How might small businesses take advantage of environmental technology? What are the barriers to transferring environmental technology to small businesses?

Just as I believe that American ingenuity can develop technologies that are competitive in the world of big business and large-scale industry, I also believe that we can find "small solutions" -- what might be termed "appropriate technology," to borrow a term in wide use several years ago. U.S. environmental technology companies are constantly improving their products, and one such improvement involves a constant effort to adapt workable systems for other applications of varying sizes. Where technologies for small businesses are concerned, I suggest that at least three criteria must be met to make pollution control systems viable: 1) such technologies must be affordable -- and generally this means they must have mass applicability rather than a few limited uses; 2) they must be simple to operate and maintain -- small business cannot run mini-chemical plants "on the side"; and 3) they must have retrofit capability -- small businesses rarely have access to the capital needed to frequently upgrade or replace production equipment as quickly as improvements in manufacturing or service industry production equipment are developed.

Financial considerations are sometimes even more critical to small businesses than to larger firms that have greater access to capital markets and diverse funding instruments. While such considerations are well beyond the scope of these remarks, the Committee may want to examine the advantages and pitfalls of such devices as revolving funds for low-interest pollution control loans -- an instrument that has been used with some success to fund municipal waste treatment needs.

CONCLUSION

Again, let me express my appreciation for the opportunity to share these thoughts with you. I will be happy to elaborate on any of these matters you wish to pursue. Thank you.

Statement of Kay V. Adams, PhD, Director, Industrial Partnership Center, Los Alamos National Laboratory

Mr. Chairman and members of this Committee, it is my honor to be here today. I am pleased to have this opportunity to share with you some of the contributions being made in the environmental area by Los Alamos and other Department of Energy National Laboratories and to give some thoughts as to how implementation of environmental technologies, including waste reduction and pollution prevention, can contribute to our nation's economic competitiveness. I also have with me today Dr. James P. Shipley, Program Director for Applied Environmental Technologies at Los Alamos.

The taxpayers of this country are making an enormous investment in the environmental cleanup of the DOE Complex. At Los Alamos alone, we plan to spend about $3 billion on environmental restoration over the next 15 years. The current FY1993 DOE ER and WM budget is over $5 billion; the DoD budget is of a similar size, at about $4 billion. The lowest estimate is that DOE alone will spend $100 billion over the 30-year lifetime of the Complex cleanup. Even these numbers, large as they are, pale by comparison to those faced by industry: some estimate as much as $110 billion for US industry to comply with current regulations this year alone.

The Office of Technology Assessment says the global market for pollution control is currently $300 billion a year. In the lucrative environmental industry, as of 1990 the United States -- once the acknowledged leader -- had fallen below Germany in level of exports, and Japan is gaining fast. Japan has chosen environmental technology as a critical technology area in which it plans to be a leader. Their Ministry of Industry and Trade (MITI) has laid out comprehensive plans to do this, primarily by forming the new government-industry-university joint research institutes, via its New Earth 21 Action Plan and its Research Institute of Innovative Technology for the Earth (RITE). The Japanese are actually building an entire "Science City" outside of Kyoto devoted to environmental and other grand challenges.

Environmental cleanup in the US is a huge expense. The environmental market is large and very competitive. I submit to you that it is perfectly possible, even imperative, for our taxpayers to realize a return on their investment, and, at the same time, for our country to enhance its competitive position in the global marketplace of environmental solutions.

With the end of the cold war, our Nation now can turn more of its resources to ensuring that a healthful planet awaits our children and grandchildren. We at Los Alamos, who helped bring the cold war to a successful conclusion, believe the Nation's 50-year investment in multidisciplinary staff, diverse technology base, and broad-based research and development facilities can be leveraged to solve our Nation's and the world's environmental problems. Ensuring that new designs, materials, and processes are developed and transferred to eliminate or minimize future environmental concerns is a goal to which we are committed.

Since we are committed to cleaning up the DOE nation-wide Complex, why not take advantage of the situation and spend our money wisely, with an eye to a national return on investment? What I mean is, let's leverage the past and ongoing public investment in these National Laboratories, in partnership with American industry, to accelerate the commercialization of innovative environmental technologies.

An investment in environmental innovation will 1) help our industries compete economically while complying with environmental regulations; 2) make protection of valuable natural resources more affordable; 3) nurture a competitive, high-technology industry, which is already facing tough competition from Japan and Germany; and 4) help optimize the reduction in environmental risk per dollar spent.

The Los Alamos National Laboratory has the strategic goal to make strong, aggressive contributions to the economic competitiveness of the United States by leveraging the public investment at the Laboratory: personnel, infrastructure and technological expertise. As part of the national economic investment plan, President Clinton last week proposed expansion of Laboratory-industry partnerships and a focus on developing environmental technologies. Specifically, the Administration is proposing a $94 million increase in this fiscal year for cooperative research and development agreements (CRADAS) with industry and universities. For FY-94, there would be an additional increase of $30 million, and $50 million increases for FY-95 to FY-98. The economic investment package also includes $1.9 billion for interagency technology development programs through the Federal Coordinating Council on Science, Engineering and Technology. DOE is involved in a number of these activities, including advanced manufacturing, high-performance computing, science and math education, biotechnology, and materials research.

At the Labs, we believe a three-pronged partnership approach will help guide future efforts consistent with the new direction proposed by the President. The three components are as follows:

1. The first component is "National Challenges" that are complex problems, the solutions to which require the advent of new technologies and/or the massive integration of existing capabilities. Meeting such challenges should advance the national well-being. National Challenges require broad and long-term (4 to 10 years) collaborations between industry and government to accomplish high-risk, high pay-off ventures. The National Laboratories can play a seminal role in ensuring technical success in such ventures.

2. The second component focuses on well defined, near term (1-3 years) technology programs. These activities involve cost-shared partnerships with industry to co-develop technologies that are market driven and may also directly benefit the US. national security.

3. The last component addresses the economic development of America through intensive collaborations between the National Laboratories and small and medium size businesses. This activity concentrates on the transfer of new and enabling innovative technologies from the Laboratories to emerging US. enterprises.

Though our resolve is strong, the task is immense, broader than science and technology. Even the most capable and dedicated scientists and engineers cannot do it alone. Only teamwork among diverse interests can result in developing and commercializing the most cost-effective solutions. Most especially, industry partnerships are the key to success. Working with industry helps strengthen our technology base. Industry brings us the market perspective -- encouraging new environmental technologies to be introduced to the commercial market faster and more efficiently. As a result, the United States can compete more effectively in the international marketplace. As the new Administration has recognized, environmental technologies represent a large growth sector for the future that could yield high returns to the US economy, particularly as world demand for environmental solutions grows. Yet, the overall winners of this global competition are the American people -- the solutions that we, all of us, create help ensure a safe, clean environment for future generations.

As you will see from the following examples of environmental solutions under development at Los Alamos and Sandia, pursued in collaboration with our industrial partners and other National laboratories, much has been done already. Much more could be done -- given the mandate and concentration of attention, as was the case during the cold war.

Industrial solvents used to clean metal, plastic, and composite parts and electronic components are widely suspected of contributing to stratospheric ozone depletion. An industry-DOE laboratory alliance (the Joint Association for the Advancement of Supercritical Technology/JAAST) has been formed to develop environmentally safe alternatives for precision cleaning of industrial parts that will not only reduce the amount of ozone-depleting chemicals being released into the atmosphere, but also will save US manufacturers at least $500 million per year in solvent costs. Charter participants of this association are Autoclave Engineers, Boeing Aerospace and Electronics, Hughes Aircraft, IBM, Los Alamos, Sandia National Laboratories, Pacific Northwest Laboratories, and the Department of Energy. A current research issue for this association is the development of supercritical fluids (SCFs) -- fluids that under certain conditions of temperature and pressure have the properties of gases. They hold promise as environmentally benign solvents and may someday replace the chlorofluorocarbons used today.

The general area of Environmentally Conscious Manufacturing (ECM), particularly minimizing or eliminating the waste generated by manufacturing processes, provides extremely fruitful ground for future environmental improvements. For example, the electronics industry requires soldering and cleaning processes as staples of their operations. Sandia has established a Cooperative Research and Development Agreement (CRADA) with Cray Research to identify environmentally safe cleaning solvents and the associated equipment to remove chemical and/or conductive material contaminants capable of producing latent system failures. In an attempt to eliminate certain kinds of solvents altogether, Sandia has also put in place a CRADA with Motorola to develop and demonstrate a self-cleaning soldering process on printed circuit boards.

Incidentally, this last effort also illustrates the issue of foreign investment in environmental technologies: the no-clean soldering process exemplifies a successful collaboration between Sandia and Motorola, the actual cleaning device is of German origin.

US industry generates over 12 billion tons of waste every year, costing some $45 billion to discard. This constitutes an enormous opportunity for cost-effective waste reduction investments by industry. The Department of Energy's Industrial Waste Reduction Program encourages the development and exchange of waste reduction and energy-saving technologies. Argonne, Pacific Northwest, Los Alamos, and Sandia National Laboratories are aggressively seeking out waste minimization opportunities with industry partners, Boeing, Hughes, and Autoclave Engineers.

We have found that industry payback from private investments in waste reduction averages only 1.8 years, which is roughly equivalent to a return of 500%. In addition, a recent Los Alamos study has estimated the broad macroeconomic impacts of DOE's investments in industrial waste reduction R&D. We found that in addition to substantial reductions in energy use, each million dollars invested by DOE generates 150 job-years of new employment, an $18 million increase in gross domestic product, and an average of 12,000 tons of waste reduction by US industry.

These estimates are very conservative because they do not include spillover and spin-off benefits that arise from the introduction and diffusion of new environmental technologies.

An example of a waste reduction project underway is a Los Alamos/Boeing effort to reduce toxic ions generated in the electroplating process and recycling them to the front end of the process. Similarly, Sandia has a CRADA with Kaehr Plating & Metal Finishing, Inc., sponsored by DOE Defense Programs, to develop technology in the areas of electroplating process improvement and control in an effort to enhance the quality and minimize the amount of hazardous waste produced.

The phasing out of chlorofluorocarbons is causing a crisis in the refrigeration and air conditioning industries, which use about 20% of the Nation's electricity. Los Alamos is contributing to investigating alternative cooling technologies. Thermoacoustics is one of these. With an industrial partner, we are developing a thermoacoustically driven orifice-pulse-tube refrigerator (TADOPTR), a new invention that refrigerates with no moving parts, sliding seals, or low temperature orifices -- only sound. It has no apparent lifetime-limiting features nor expensive components. It is exceedingly simple, consisting only of assorted tubes and heat exchangers. No exotic materials are needed: only brass, copper, stainless steel, and helium gas are required in the first TADOPTR. The technology is so new that its ultimate limits will not be probed for many years.

High-level radioactive waste management is another difficult problem facing our country. One of the problems associated with siting a geologic repository for radioactive waste, such as at Yucca Mountain in Nevada and the Waste Isolation Pilot Project, is the requirement of certifying the repository from intrusion and leakage for time periods on the order of 10,000 years. This is due to the long half lives of the wastes to be stored in the repository. To address the defense and commercial high-level waste and other national issues, Los Alamos has initiated the accelerator transmutation of waste (ATW) program. A high-energy proton beam produced by an accelerator is used to create high-energy neutrons through a process called neutron spallation. These neutrons induce reactions in waste products, transmuting all the actinides and most of the long-lived fission products. The waste resulting from this process includes predominantly stable nuclei or materials with half lives below 30 years. This process could dramatically complement national waste management strategies. The system is capable of producing far more energy than consumed by the accelerator and becomes an advanced fission energy source for electricity production, with minimal nuclear waste production. Los Alamos is collaborating with several industry partners as well as other national laboratories to examine this idea to destroy plutonium in the Former Soviet Union in a program called accelerator based conversion (ABC).

Hot Dry Rock (HDR) energy is natural heat stored in formations that lie deep within the earth. Extracting this clean energy source holds great promise both economically and environmentally. The world's resource base for fossil fuels is estimated at 360,000 quads, while that for HDR is estimated at more than 10 million quads. Studies have shown that HDR power could be produced for 5-9 cents/kilowatt-hour. Heat mining is a closed-loop process that emits no greenhouse gases, has no adverse effects on surface or groundwater and produces no residual waste. Los Alamos is the recognized world leader in this technology. The Japanese, and Europeans are also moving ahead on the technology with multi-million dollar R&D programs.

At current levels of effort, they are rapidly gaining on the US technologically.

Another example of research at Los Alamos in the intense drive toward energy-efficient, waste minimizing processes is the advanced materials program funded by the DOE Office of Conservation and Renewable Energy. These activities include the development of advanced high temperature materials such as intermetallics and advanced catalysts required by chemical and automotive industries. Intermetallic materials such as molybdenum disilicide ($MoSi_2$) reinforced with zirconia are of particular interest to industrial firms for high efficiency, high-temperature applications. The increased reliability promised by the new materials will also reduce costs, down time, and energy consumption. The LANL research in catalysis will result in computer-designed catalysts, which promise energy saving shortcuts to selection of these important materials. The current research will also lead to the fundamental understanding of automotive catalysts employed to reduce emissions. Catalysis is a $6 billion industry worldwide and supports industries that produce goods worth 100 times that amount.

One of the principles that continues to be validated is that energy, environment, and economics are inextricably intertwined. Almost all industrial processes use energy in some fashion that may have various costs and impacts on the environment, depending on how intelligent we are about the way the energy is used. The concept is embodied in the phrase Environmentally Conscious Energy Efficiency, of which the HDR program is an example. Additional examples follow.

In transportation, the proton-exchange-membrane (PEM) fuel cell has important advantages: very low emissions, high energy efficiency, high power density, and the use of methanol as its fuel, an alternative fuel of high US domestic availability. Since the early 1980s, Los Alamos has engaged in research on the PEM fuel cell as an alternative power plant to the internal combustion engine. Various industrial collaborators have joined in this research. General Motors is now working with Los Alamos using both DOE and corporate funds to produce an electric vehicle powered by a 10-kilowatt PEM fuel cell, to be ready by June 1993. Besides being environmentally benign, this fuel-cell-powered electric vehicle will have a range between refuelings comparable to that of present day passenger cars, thanks to the much higher power density of the fuel cell.

Los Alamos is making other significant contributions to the automotive industry and to a cleaner environment. The Laboratory has been part of working groups including General Motors, Ford, Chrysler, Cummins, Caterpillar, and others, in combustion research. One of the products that has resulted from this union is the KIVA combustion computer code. KIVA is a multi-dimensional, multi-phase (combustion) fluid dynamics computer code dating back to the 1970s and originally developed for military applications. Run on a supercomputer, KIVA now is used to model events that occur in an internal combustion engine, including air flow, fuel spray, combustion, and exhaust. Automotive engineers in the US and in other countries are using KIVA to observe the combustion process in more detail as a part of designing clean burning and more fuel-efficient engines. In 1992, Cray Research obtained an exclusive license to make KIVA more user friendly on its platform and to improve the code's graphics and data analysis capabilities. Los Alamos, Lawrence Livermore, and Sandia National Laboratories are working with the "Big Three" automobile companies to develop low NOX-emission technologies.

Los Alamos was one of three national laboratories which formed the pioneering

Superconductivity Pilot Centers. DOE funded the laboratories directly and they were encouraged to form cost-sharing partnerships with industry to co-develop high temperature superconductors. The partnerships were and are particularly effective because the laboratories (Los Alamos, Oak Ridge, and Argonne) are allowed to select the specific research issues and then select industrial partners with similar strengths and interests. Los Alamos has signed 23 agreements with large and small companies and the expected result is accelerated commercialization of high temperature superconductor technology. Superconducting materials promise reduced transmission losses and cost-effective storage of electrical power. Widespread use of superconductors will reduce oil/energy consumption and will result in a cleaner environment.

Los Alamos and Sandia have formed the Oil Recovery Technology Partnership (ORTP) with the domestic oil industry (majors, independents, and service companies) to use the scientific and engineering resources at the Laboratories to assist the industry in oil recovery. Technology developments at these Laboratories have immediate applications faced by the oil industry. Similar to the Superconductivity Pilot Centers, the Laboratories share risks and costs to transfer new technologies for enhanced oil recovery. The government pays for the Laboratories' participation, and the companies pay their own costs. Funding in FY93 was $3M, and an additional five-year effort has been proposed. This new initiative has and will continue to transfer existing technology, largely derived from federally funded weapons and energy research, directly to the oil industry. The domestic oil industry guides the R&D efforts proposed as part of this initiative.

Microwave heating research to replace fossil fuels now used in manufacturing processes is also underway at Los Alamos. The benefits of this research will be reduced emissions and greatly increased energy efficiencies. The current effort at Los Alamos involves rapid curing of ceramic fibers and fabrication of high-density components through chemical vapor infiltration (CVI). The CVI process uses microwave heating of net-shaped components to promote the required chemical reactions. It is projected that this new process would take only two hours, a vast improvement on the foreign process now in widespread use which takes up to two weeks. Several private-sector companies are interested in commercializing this technology.

A 1992 R&D 100 Award Winner, an honor given annually by Research and Develop-ment Magazine to the one hundred most significant technical innovations of the year, Los Alamos's plastic dye-laser rods offer a replacement for toxic liquid dye-solvent solutions currently in use. Dye lasers are a type of tunable laser in which the medium, the material that produces the laser beam, is an organic dye. To change the wavelength, the laser operator must change the dye. Often, the purged dye-solvent solution must be handled as regulated hazardous waste. Our laser dye rods are environmentally benign, permit finer wavelength tunability, and increase efficiency by 50%. Numerous industry inquiries have been received about this technology.

One of the Committee's questions concerned the principle barriers to further development of environmental solutions. In my opinion, the barriers come in three major types: 1) institutional, in which the technology transfer mechanisms have too-often been encumbered with well-intentioned provisions-become-obstacles designed to ensure fair competition and US preference; 2) the lack of clear mandate, or uncertainty as to whether the National Laboratories ought, or are even able, to contribute to solving the Nation's environmental/energy/economic problems; this barrier often manifests itself in inadequate resources to get the jobs done; and 3) the lack of sufficient skills at transferring technology cost-effectively, which occurs because of inadequate, but rapidly increasing, knowhow within the National Laboratories about working with industry, and because of a complementary set of deficiencies on industry's part. We are still learning to work together, but we will learn.

As an example, we and industry are searching for different and better ways of partnering. This is one of the reasons why we, collectively, have been so interested over the course of the last year or so in the so-called "Enterprise" and Strategic Laboratory Council exercises sponsored by the Department of Energy's Office of Environmental Restoration and Waste Management. We believe that the results can form the basis for further discussions among the environmental community, including industry, with a view toward designing increasingly effective processes and structures for enhancing the Nation's economic competitiveness and environmental well-being. An additional concept that we urge be considered is that of multi-organizational partnering within government agencies, and even multi-agency relationships that could do much to use resources most effectively.

With respect to small businesses, non-federal organizations can leverage the impact of the National Laboratories with small business. RioTech in New Mexico is such an organization. In collaboration with Sandia and Los Alamos National Laboratories and with assistance from numerous New Mexico economic development and educational institutions, RioTech's Environmentally Conscious Manufacturing Institute promotes environmentally conscious solutions to manufacturing problems. Workshops and educational opportunities are available to individuals and companies throughout the State with a particular emphasis on small business.

Likewise, Sandia and Los Alamos cooperate in the DOE's ECO Manufacturing Program, designed to promote the transfer of environmentally conscious manufacturing to small business through technical assistance and training. This program is almost like the Agricultural Extension service of old, using a partnership network among the universities, community colleges, the State of New Mexico, and the SBDC to make these services available to small businesses.

Many National Laboratories have programs encouraging small business to take advantage of their technical expertise and resources. Los Alamos, for example, has established a technical assistance program in cooperation with the State of New Mexico's Manufacturing Productivity Center. Several referrals under this program have proven invaluable to the small company as the technical problem addressed was of such gravity that the company's survival was at stake.

Partly as a result of such interactions, we have learned that, in fact, small businesses are actually doing more technology development than many larger businesses. The reason? Because technology is often their best, or only, entre′ into the environmental field. In such cases, the contribution that institutions such as the National Laboratories could make might best fall under the heading of lending credibility. That is, small companies generally are most in need of capital, which comes easier if they can generate support from a recognized body of expertise.

We are also working hard internally to become more effective industrial partners. For example, this last October Los Alamos held a pilot Technology Commercialization Workshop, with the integral participation of industry representatives. The focus was on

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showing ten individual principal investigators, scientists and engineers, how to navigate the commercialization process for their own environmental technologies being developed at Los Alamos. They wrote business plans that were mercilessly criticized by their industrial mentors, but that ultimately became much better for it. The lessons were hard but practical, but the most gratifying outcome was the enthusiasm of the principle investigators, these ten R&D scientists and engineers, for having learned a little more about working with industry. We will be extending this effort this year.

We are also investing "our own" resources in the environmental field. This year, for example, Sandia will spend approximately $5 million of its discretionary Laboratory-Directed Research and Development funds on environmental technology development. Los Alamos has a similar program.

We cannot be shortsighted in our efforts. Finding today's environmental solutions and reducing environmental concerns for tomorrow are just the initial steps. For the United States to remain technologically competitive, it must have a talented, multidisciplinary work force to address future technological and environmental issues. We must help inspire and educate our next generation of scientists and engineers.

Several programs seek to involve students with hands-on science opportunities. Established in 1990, SWOOPE (Students Watching Over Our Planet Earth) is an innovative environmental science education program applicable to students from kindergarten through high school. Students investigate real-world environmental problems and provide data to scientists who are involved in the solutions. In 1989 the Department of Energy, through its Albuquerque Operations Office, formed the New Mexico Waste Education and Research Consortium (WERC) to train waste management specialists at New Mexico institutions of higher learning. New Mexico State University leads this effort. Consortium members such as Sandia and Los Alamos National Laboratories use their own discretionary resources to nurture and encourage this program.

Finally, I hope that the information I have given you might go some way toward eliminating the second barrier that I described earlier: the lack of a mandate for the National Laboratories to help in the environmental area. Clearly, we have the technical horsepower to be able to contribute. We would agree that the technology transfer process does not function nearly well enough yet, but we are working hard, with industry, to improve it as rapidly as possible.

There is perhaps a larger, more important point here: for the Nation to thrive in an economic competitiveness sense, we must learn how to put good, new ideas into practical use, and do it more cost-effectively than any of our competitors. What better vehicle to pursue that grand challenge than the cradle of modern technology rocked by the hand of the world's most powerful industrial base?

We recommend, then, the following approach:

1) Leverage the nation's fifty-year investment in facilities, experienced teamwork and capabilities,

2) Focus appropriate elements of the Laboratories on the environment while maximizing the dual benefits to defense,

3) Partner with environmental stakeholders: industry, universities, regulators, and the public,

4) Use those partnerships, along with information on global problems and solutions, to nurture an environmental industry ready and eager to compete globally, and

5) Build environmental infrastructure for the long term, while cost-effectively attacking immediate problems.

It has been said that, if all we do with the enormous resources that will be spent on the DOE Complex over the next 30 years is to clean up the Complex, then we will have failed. Let us make a much wiser choice. Let us learn as we go from that cleanup: how to do it more cost-effectively and in partnership with US industry.

We at Los Alamos and the other DOE National Laboratories believe we can help achieve these worthy goals. We ask you and the Congress for the mandate for the National Laboratories to lead the effort in the Complex clean up and at the same time enhance our Nation's competitive position in the global marketplace.

I will be happy to provide more detailed information on these and other initiatives of interest. Thank you for the opportunity to talk with you.

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